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EDWARD J. RYAN, B.S., D.D.S., Editor
ETHEL H. DAVIS, A.B., Assistant Editor

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THE CORRECT BASIS FOR ACCURATE FULL DENTURE CONSTRUCTION

LEONIDAS SMITH, D.D.S.
Indianapolis

CAPABLE investigators have made it possible to arrive at a good understanding of the subject of full denture construction, and to build an artificial denture that will fulfill the offices of the natural teeth in appearance and efficiency better than any other anatomic substitute. An artificial limb is a necessary but poor substitute; an artificial eye cannot see; but artificial teeth can be made to do their bit pretty well. Much has been written and taught that is so complicated that it has, in a measure, retarded the average operator. The geometry is there all right but the end-result of it is what is wanted. It is simpler to obtain the measurements directly from the mouth and transfer them to the articulator instead of trying to work them out on paper, then on the articulator, and then trying to make the measurements fit the mouth.

For six years I have found it unnecessary to regrind, mill, or otherwise interfere with the occlusion of dentures after having placed them in the mouth. Milling closes the bite and rearranges the mechanical sequence of the case, destroying the occlusal plane. Fortunately, the expense to change from any other technique to the one suggested herein is small. A good adaptable base plate material, metal that can be burnished, or vulcanite; a piece of brass plate about 20 gauge, large enough to extend across the lower jaw; a screw, such as a stove bolt, size 1 inch by one-eighth; and an articulator with adjustable condyle paths, and with a so-called incisal guide pin, which can be removed for everything except to maintain the intermaxillary space, are all the equipment necessary. Hoop brass can be purchased in long pieces of the proper width, and cut off the right length for the case. The corners are cut off one side so that the brass will approximate the shape of the jaw (Fig. 1).

One of the greatest stumbling blocks in the past has been to get centric relation and register the condyle paths. This is easily done; if the patient is given a chance he will always register both correctly. It is then only necessary to build on the foundation the patient gives the operator.

A great deal has been heard about a section of the curve of an eight-inch sphere. To say the occlusal plane is a portion of an eight-inch sphere is only a generalization. It is not the truth, but leads close to the truth. It is like saying an apple is round. It can be used for the occlusal plane in the same sense that an apple can be used as a pattern for a billiard ball, and no more. If an apple happened to be round it could be used as a pattern for a billiard ball, and if both condyle paths happened to be on an inclination of 20 degrees one could use a portion of an eight-inch sphere as the occlusal plane, or the curve of Spee. Since this seldom occurs one must know whether it is true before attempting to use the eight-inch sphere as the plane of occlusion.

Centric relation, correct intermaxillary space, and the accurate registration of the condyle paths comprise the foundation for a perfect denture, which cannot be built on any other foundation. Observation will disclose the fact that most people enduring artificial dentures do all their mastication on the median line, and do not bring the lateral or grinding action into use, thus the condyle paths are not used. Patients locate the only place they can chew, and do the best they can. This adaptability on the part of the patient is the reason the dentist "got by" so long in prosthesis. This is not the kind of service patients deserve. Perfect occlusion in all positions of the mandible results in perfect adaptation at all times, producing stability, comfort, and efficiency. This contributes more to the success of full dentures than any other one factor. All that is necessary is to obtain the results of the motions of the jaws, on the plane of occlusion, record these results on the articulator, and set up the teeth.

The mandible can be moved in all directions, but the occlusal plane is fixed. The condyle paths govern the occlusal plane. The condyle paths are more easily and more accurately registered on the median line than by taking lateral bites. Bringing the mandible forward on the median line about 5 mm. at the established intermaxillary space, under biting stress, and sealing the bite plates together in this position accurately registers the course of both paths the simplest way. In fact, to register the condyle paths is to register the lateral bites. The process of taking lateral bites is more complicated and less accurate.

The dentist who can obtain balanced occlusion without taking into consideration the movements of the condyle heads in their paths can build a steam locomotive without eccentrics. There is no such thing as an average case. Each case is a law unto itself. Condyle paths are as individual as fingerprints.

Fortunately, after so long a time dentists are learning that they are building dentures and that they are doing so on two units instead of thirty-two. Nature cannot be followed all the way. We are bound hand and foot by the law of mechan-

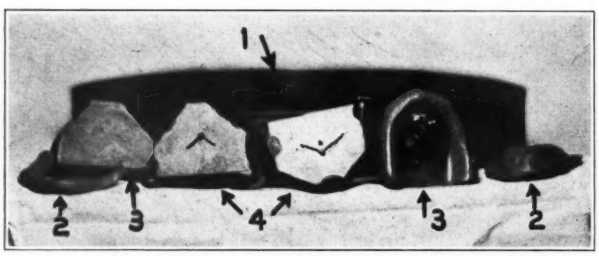


Fig. 1—Materials for bite: (1) long strip of hoop brass; (2) base plates formed; (3) brass plate and screw mounted for use; (4) Gysi Gothic Arch tracings.

ics, and simplicity is the key. Dentists are learning that natural teeth, cusps and all, were designed for the thirty-two unit denture as made by Mother Nature. Duplications of natural posterior teeth are not mechanically adapted to artificial substitution. A beginning has been made to design teeth suitable for artificial posteriors, but we have a long way to go before the field is adequately covered. Posterior teeth should be designed so as to conform to masticatory function, regardless of any particular spacing anteroposteriorly. The plane of the tooth should be in accord with the inclination of the condyle path. A flat tooth can only be used successfully when the inclination of the condyle path is zero. Anterior teeth are now made satisfactorily. Anterior teeth should be set up with necessary overjet, overbite, and esthetic considerations, and independently of the posterior teeth.

When teeth are set up in centric relation and proper intermaxillary space much more power can be exerted in chewing. More teeth will be broken, because of greater stress in biting. The paths of the condyle heads are varied by opening or closing the bite. Different degrees of intermaxillary space produce different inclinations of the condyle paths, and as the action of the condyle paths comes into use only when the dentures are in lateral occlusion, the registration must be made on the median line, with a fixed intermaxillary space, after which, lateral movement establishes the occlusal plane.

A simple, accurate, almost automatic method of locating centric relation and the condyle paths, and transferring them to the articulator exists. At the same time the base plates are automatically seated, without which the accurate location and registration of the condyle paths would be impossible. While simplicity is stressed in this operation, unless it is accompanied by accuracy there is absolutely no advantage. To guess at one point and be accurate at all others will not do.

Requirements

1. Good impressions must be made under biting stress.

2. The intermaxillary space must be fixed and maintained throughout the construction of the case.

3. The condyle heads must be accurately located under biting stress, in centric relation.

4. The superior cast must be accurately mounted with a face-bow.

5. Bite plates must be sealed together in centric relation, under biting stress, and the lower cast mounted on the articulator.

6. The protrusive bite must be accurately taken on the median line, under biting stress, and sealed.

7. Casts must be accurately seated in this bite, and the condyle adjustments fixed. Casts must be accurately seated in the base plates at all times.

8. One should make sure that the patient is biting by examining the masseter muscles to see that they are tense.

Impressions

If impressions are taken under biting stress a foundation is established which is as unchangeable as possible, and the following technique will maintain that stability all the way through. This in itself is of major importance. Each step has a relation to all the others which precludes a break in continuity.

Bite rims should be discarded as inaccurate. The force of the bite should be applied in the center of the impression trays so that the pressure will be distributed equally in all directions, and the soft tissue compressed as it will be when chewing. Bite rims deliver all the stress on the first hard tissue encountered, and cannot be accurate.

It is an advantage to take a preliminary impression, and on the resulting cast form a close-fitting impression tray of some adaptable material. This is trimmed with a vulcanite file until it fits the mouth accurately (Fig. 2).

Fig. 2—Impression trays formed over preliminary casts.

1. A ridge of modeling compound is built on the lower impression tray to about the occlusal plane of the teeth.

2. A brass plate (Fig. 3 A) is attached to this, as mentioned previously, care being taken to place it level with the occlusal plane. This brass plate should be as wide as the tray, and extend from the incisal region to the distal of the second molar region (Fig. 4 A).

3. With modeling compound a screw with the nut in place (Fig. 3 B) is attached to the palate of the superior tray, with the nut close to the surface and the end of the screw snug against the base plate. This screw should be of proper length for the case, with the head cut off and rounded on the exposed end so that it will mark the brass plate without scratching (Fig. 4 B). The screw can be adjusted to obtain the proper intermaxillary space.

B A

Fig. 4—A, brass plate mounted on lower impression tray; B, screw attached to upper impression tray with modeling compound.

4. Modeling compound is placed on the edges of the rims which are then muscle trimmed.

5. The superior tray is postdammed with carding wax (Fig. 5). With this arrangement it is not difficult to take an impression under biting stress.

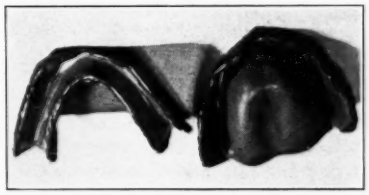


Fig. 5—Impression trays muscle trimmed and upper cast postdammed with carding wax.

6. With a plaster wash in the upper tray, the upper impression is taken under biting stress by having the patient close with the screw bearing on the brass plate of the lower impression tray (Fig. 6 A).

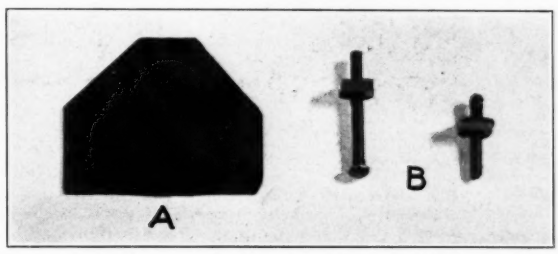


Fig. 3—A, brass plate; B, screw made from stove bolt, showing screw with head cut off and ready to use.

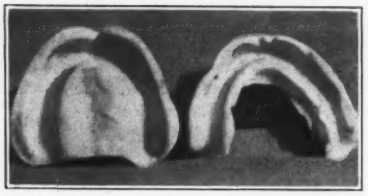


Fig. 6—Completed impressions taken under biting stress.

7. This impression is put aside and another base plate built just large enough to turn over the ridge, with the screw in the palate as before.

8. This base plate is used to apply pressure while the lower impression is taken (Fig. 6 B). One should make sure the patient is biting by examining the masseter muscles to see that they are tense. Exerting pressure in the center of the plates distributes the pressure equally to all parts of the mouth.

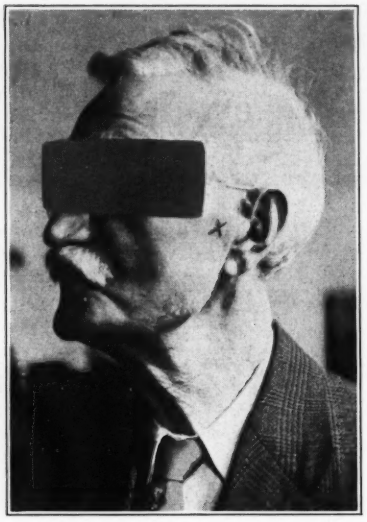


Fig. 9—Cross marking condyle head, made with soft lead pencil.

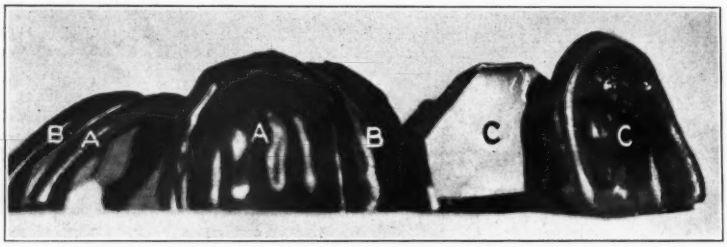


Fig. 7—Two lower and two upper base plates, A and B, one of each for taking bite and mounting casts on articulator, the other two for building occlusal plane and setting up teeth. C, Upper and lower base plates shown with brass plate and screw for taking bite.

Registration of the Bite

1. With some adaptable material two base plates are formed on each cast, extending just over the ridge (Figs. 7 A and 7 B).

2. A metal plate is placed across the lower just as has been described for the impression tray (Fig. 7 C).

3. A screw is attached in the palate of the upper base plate as before (Fig. 7 C).

4. The base plates are placed in the mouth, and by adjusting the screw the intermaxillary space is determined.

5. The patient is instructed to move the mandible in all directions and mark the brass plate with the end of the screw under biting stress. This will establish the Gysi Gothic Arch, *the apex of which is the centric relation* (Fig. 8 A).

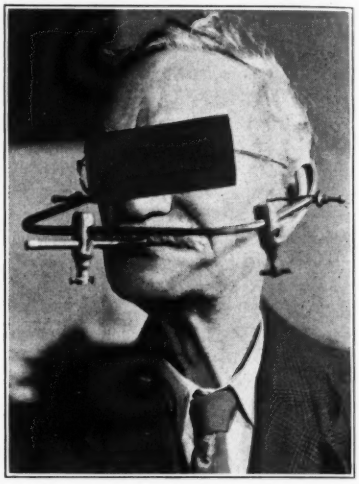


Fig. 11—Face-bow in place. Patient holding base plates accurately seated by biting on brass plate with screw.

6. The lower base plate is removed from the mouth, and with a number 8 round bur a depression is cut one-half the depth of the bur at the apex of the Gothic Arch (Fig. 8 B). The lower base plate is replaced in the mouth and the patient is instructed to bite with the screw in this depression. This makes it easy for him to find and hold the centric relation.

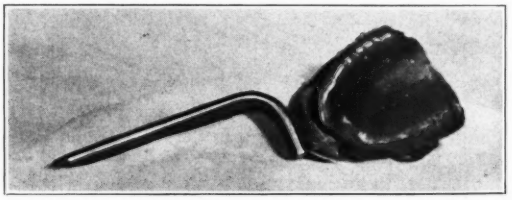


Fig. 10—Mouthpiece of face-bow attached to upper base plate with wax.

7. While the patient opens and closes in this position the heads of the condyles are located and the position marked by making a cross with a soft lead pencil as a guide in placing the face bow (Fig. 9).

8. The upper base plate is removed and the mouthpiece of the face-bow attached with wax (Fig. 10); then, it is replaced in the mouth.

9. While the patient is holding this in the correct position under biting stress, the face-bow is attached. This will seat the condyle heads in the retarded position and hold the base plates accurately seated while the dentist adjusts and tightens the face-bow (Fig. 11).

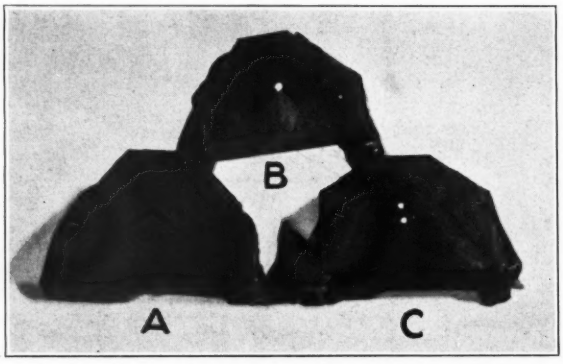


Fig. 8—Tracings: A, Gysi Gothic Arch tracing; B, with depression drilled at the apex marking centric relation; C, with second depression 5 mm. posterior for protrusive bite.

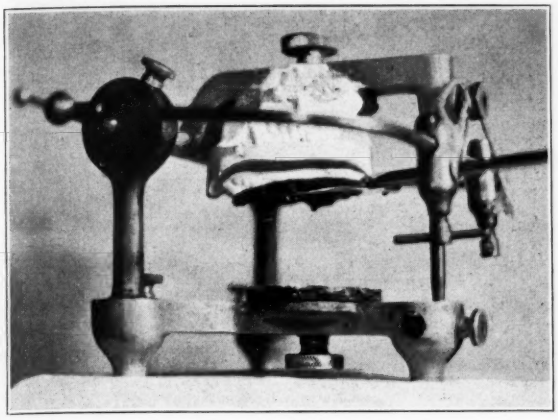


Fig. 12—Mounting superior cast on articulator with face-bow.

10. The superior cast is mounted on the articulator with the face-bow. *One should be certain that the cast is accurately seated in the base plate* (Fig. 12). Notches should be filed in the rim of the base plates so that the casts can be seen, thus assuring actual seating, as is shown in Fig. 14.

11. The base plates are returned to the mouth, and while the patient holds the screw of the upper base plate under biting stress in the depression just made in the lower metal plate, the bite plates are sealed together with a quick-setting plaster mixed thick (Fig. 13). One should be sure the screw remains in the depression.

12. The lower cast is mounted with this bite, *care being taken to have the casts seated in the base plate,* and to have the guide pin of the articulator in position to maintain the intermaxillary space (Fig. 14).

Both casts are now mounted in centric relation, in proper intermaxillary space, and in correct relation to the condyle heads.

13. The plaster is removed from the bite just taken. With a number 8 bur another depression is drilled 5 mm. posterior to the apex, the Gysi Gothic Arch tracing being bisected (Fig. 8 C).

14. The base plates are replaced in the mouth, and the patient is instructed to bite with the screw in the posterior depression. This brings both

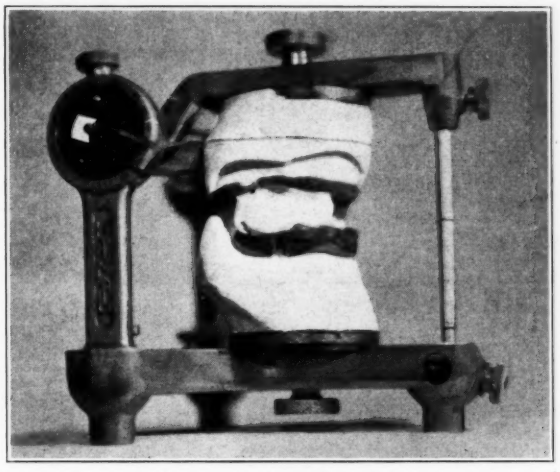


Fig. 14—Mounting lower cast with bite plates sealed together in centric relation.

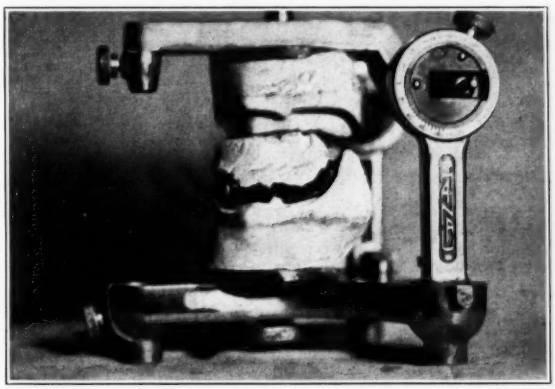


Fig. 15—Condyle paths of articulator adjusted to the bite sealed together in protrusive relation.

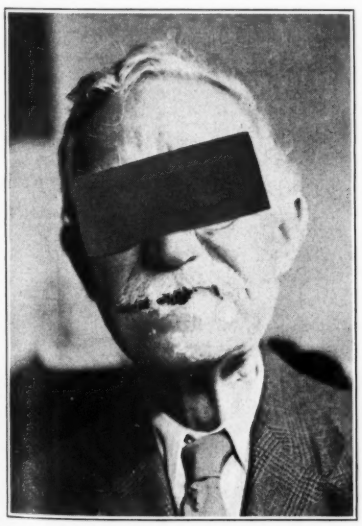


Fig. 13—Bite plates sealed together in mouth with plaster.

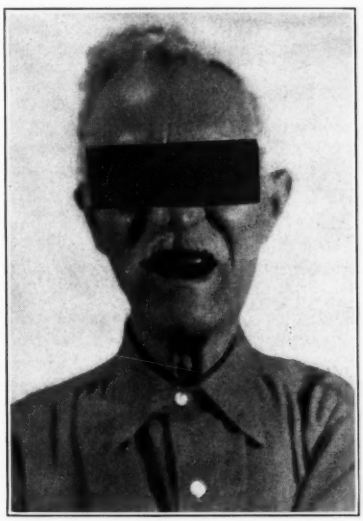


Fig. 16—Registering contour of upper lip and other markings on bite rim.

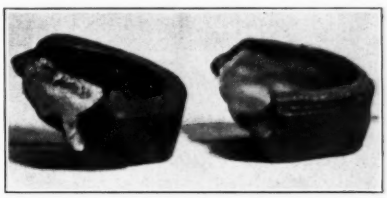


Fig. 17—Appearance of bite rim when removed from mouth, and again after roll of wax is attached to occlusal surface.

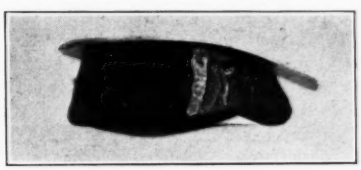


Fig. 18—Roll of wax melted down with hot templet to form an approximate curve of Spee.

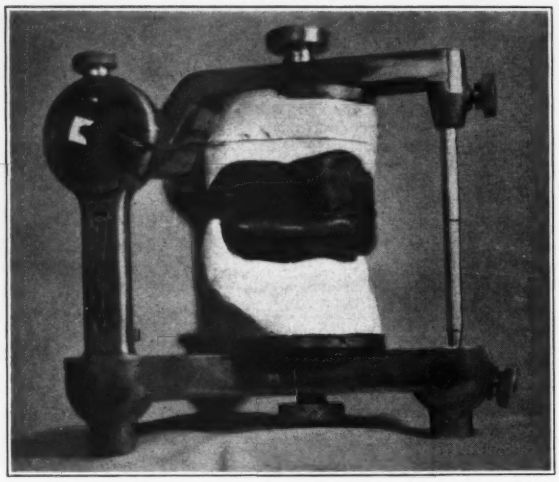


Fig. 19—Articulator closed on soft roll of wax on lower base plate.

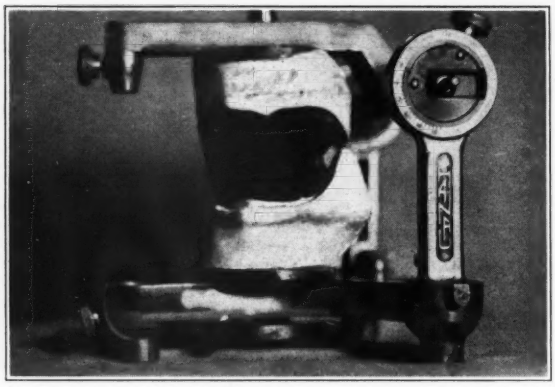


Fig. 20—Bite ridges with approximate curve of Spee established. Note curve made by templet while condyle path is zero.

Fig. 21—Bite shown in Fig. 20 in protrusion; this is what happens to curve when jaw is protruded and the condyle path is level.

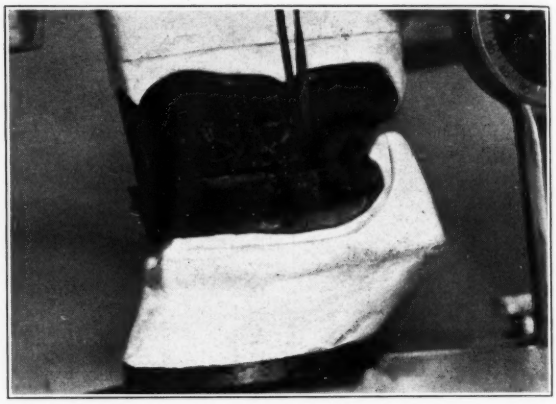


Fig. 22—Correction of bite as shown in figures 20 and 21 so that it is made to conform to the inclination of condyle path, which in this case is level.

condyle heads forward on the median line, the distance between the two depressions, which is as far as they will ever travel in chewing, and automatically registers both condyle paths.

15. This is sealed with plaster under biting stress, as with the centric bite (Fig. 13).

16. To register the condyle paths on the articulator the bites are sealed firmly with hot wax, the incisal guide pin is removed, and all tension is removed from the articulator. This bite is placed in the articulator, with the condyle paths at zero, and the condyles of the articulator are adjusted until both casts are accurately seated in the base plates (Fig. 15). This operation holds the base plates in such a position that it is impossible to seat the mounted casts until the condyle paths of the articulator are adjusted to the same position as those of the patient. Whatever is built on the articulator in this position will function the same way in the mouth.

A simple means of procedure from this point is as follows:

1. On the second set of bases (Fig. 7 B) the upper bite ridge is built and the contour, lip line, median line, length of teeth, and so on, are recorded as usual (Fig. 16). The intermaxillary space has already been registered on the articulator, and it is not necessary to build the lower bite ridge in the mouth.

2. With a soft roll of wax attached to the lingual half of the occlusal surface of the upper bite ridge (Fig. 17), a hot templet is used (which represents a portion of the surface of an eight-inch sphere). This roll of wax is melted, and an approximate curve of Spee formed (Fig. 18). One should be careful, however, not to disturb the outer periphery of the occlusal plane.

3. This bite ridge is chilled; vaseline is put on the occlusal plane, and with the guide pin in place, the articulator is closed on a soft roll of wax placed on the lower base plate in the articulator (Fig. 19).

4. The excess is trimmed away, and both bite ridges are on the articulator with an approximate curve of Spee established (Fig. 20).

5. The incisal guide pin of the articulator is only used to maintain the intermaxillary space and has nothing to do with the occlusal plane. It should now be removed, and only replaced at intervals to check the intermaxillary space, which must be maintained throughout. The occlusal plane is the guide for setting up teeth.

6. If the inclination of both condyle paths is plus 20 degrees, one can set up the teeth and be correct. Any variation from 20 degrees in the inclination of either condyle path must be compensated for by trimming off and adding wax as necessary (Figs. 21 and 22).

7. The superior anterior teeth are set up for esthetics. The superior posterior teeth are set up by removing wax sufficient for one tooth at a time and setting the teeth to conform to the already established occlusal plane by closing the articulator with the tooth in place against the lower bite ridge. Of course teeth must be set well over the ridge. The lower

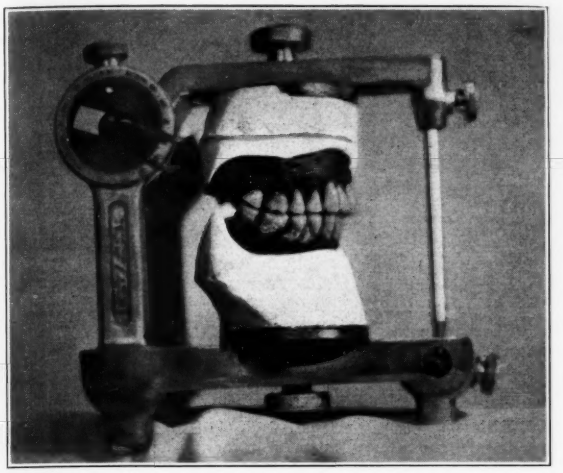


Fig. 23—Second molar tilted to conform to the degree of overbite.

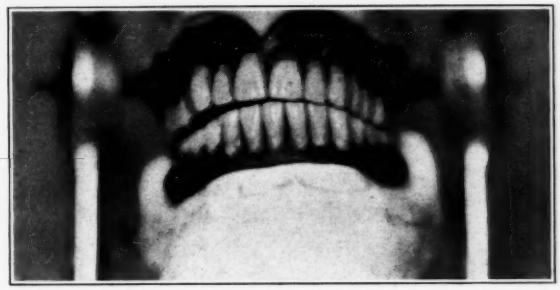
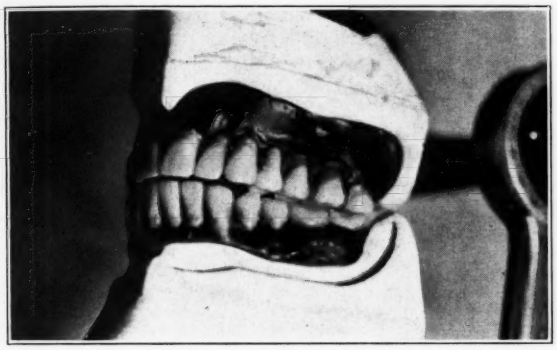


Fig. 25



Figs. 24 and 25—Dentures in lateral occlusion after teeth have been set up to the correct occlusal plane. Teeth are in occlusion in all positions.

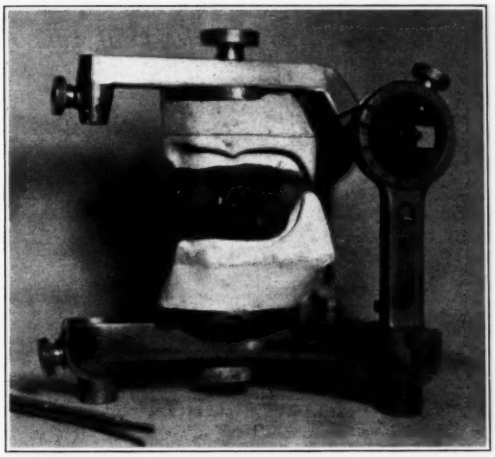


Fig. 26—A simple and direct distribution of pressure seating base plates and condyle heads so that bite plates operate thoroughly when in the mouth.

anteriors are set where desired, and the lower posteriors are set to the superiors.

If one condyle path is steeper than the other the inclined plane of the posterior teeth on that side will have to be greater than on the other. When the inclined plane of a tooth is parallel with the inclination of the condyle path, it is level with the movement of the jaw and will not produce trauma.

The articulation of the teeth is now regulated until every fine adjustment is completed so that occlusion in all possible positions is a fact. One should be careful of thermal changes until the investment is completed; then the case will need no further grinding or milling to make it fit.

Suggestions

1. The majority of changes that take place in vulcanizing or pressing dentures come from wax changes rather than displacements in the plaster. Care should be observed to maintain room temperature at all times, and room-temperature plaster and water should be used for investment. Only a careless operator would misplace teeth during packing or closing a flask.

2. To compensate for an overbite, which is desirable to make it possible to incise food, the second molars on both sides are tilted to equal the depth of the overbite, and adjusted to maintain the curve of Spee (Fig. 23). It is possible to get many effects when one knows the action of the jaws and knows that it is registered on the articulator, for anything that will work on the articulator will be correct in the mouth.

3. Any kind of tooth may be used, because when one works out balanced occlusion in all positions on the articulator, by grinding, the desired result is accomplished (Figs. 24 and 25).

4. For those who send their cases to the laboratory it will be necessary to carry the bite through to having built the superior bite rim, restoring the contour of the upper lip, and other markings usually made, then send the case on the articulator. The only try-in necessary will be for esthetics.

Conclusion

If one starts with impressions taken under biting stress, in such a way that equal pressure is distributed to all parts of the mouth and condyle heads, followed by bites taken the same way, and the condyle paths registered under the same conditions, the resulting occlusal plane must be correct.

NOVOCAINE DERMATITIS

Doctor T. C. Reid of Detroit suggests the following prescription as a remedy for novocaine dermatitis:

Benzoic acid, 60 grains
Salicylic acid, 30 grains
Thymol, 8 grains
Cold cream, in sufficient quantity to make 1 ounce.

Apply on affected parts. Rub in well. Do not cover fingers with gauze.

THE DENTIST AND SYPHILIS*

M. J. EXNER, M.D.
New York

BECAUSE syphilis is so widespread and invades every stratum of society, every dentist must expect among his patients a proportion who have this disease. Syphilis is in certain stages highly contagious, and when untreated it is extremely varied in its manifestations and disastrous in its consequences. It is, therefore, incumbent on every dentist to be constantly on the alert for manifestations in his patients which may indicate syphilis, both for his own protection and for the protection of his patients. Syphilitic infection of dentists through professional contact with patients, and infection of patients by way of dentists' instruments do occur. The emphasis, however, in this article is on the public health function of the dentist in relation to this disease.

Although syphilis presents one of the greatest of public health problems, it is a problem with a hopeful aspect. The disease is well understood as to cause and course; accurate means for its diagnosis are available, and more so than in any other serious malady, a favorable outcome can be confidently predicted when the disease is early and adequately treated. The public health problem of syphilis is mainly one of early detection and early and adequate treatment in all cases. In bringing this about the dentist can be of service.

It is difficult to name a single figure that would represent the prevalence of syphilis in the United States, both because of lack of data and the wide variation according to social or economic class. We are slowly gathering, however, a body of evidence as to the wide distribution and frequency of the attack of syphilis which is impressive and surprising. Our reliable information is based on officially reported cases, censuses of known cases, and "Wassermann surveys."

It is known that syphilis is generally reported far less completely than any other communicable disease except perhaps gonorrhea. A large proportion of diseased persons do not come under observation or treatment. Many resort to self-medication, to drug store prescriptions, or treatment by quacks. Many more are not aware at all that they have the disease. The initial lesion may have been obscure; the secondary lesions have been mistaken for some other condition; and the disease has passed into a latent stage when no apparent indications appear. For example, of 165 patients with syphilitic cardiovascular disease who came to the Johns Hopkins Hospital, 49 per cent had no idea that they had syphilis until the diagnosis was made on admission to the hospital.

One-day censuses of known cases under medical care in twenty-five communities representing 20 per cent of the population of the United States yielded a rate of 4 per thousand of population for white persons and of 7.2 per thousand for Negroes. These data were obtained from reports of all physicians, hospitals, and clinics of the number of cases under observation or treatment on a given day.

That these figures based on known cases are conservative is suggested by a recent study made by the United States Public Health Service in six counties of five southern states in which a cross section of the Negro population was serologically tested. It revealed a rate of 217 syphilitic persons per thousand of the population, as compared with 7.2 per thousand shown in the study of reported cases.

While no similar cross section study of the white population has been made, it is justifiably assumed that such a study would reveal a similar disproportion among white persons between actual infection and infections under proper medical care. An indication of this fact is given by Wassermann surveys of different limited groups of workers in various parts of the country which showed the following percentages of syphilitic persons: A group of milk handlers, 4 per cent; a group of railroad employees, 11.7 per cent; a group of laborers, 6.1 per cent; a skilled and semiskilled, and clerical group, 3.5 per cent. In prenatal clinics, also, valuable information is available as to syphilis among women. The average prevalence among 30,000 women in a number of clinics was almost 10 per cent, 6 per cent among white women, 15 per cent among colored women.

That it is important for the dentist to possess what Stokes has aptly called "a high index of suspicion" with regard to syphilis is emphasized by the frequency with which the most infectious syphilitic lesions appear about the head and especially in the buccal cavity, the areas with which the dentist is professionally concerned. Chancres of the lips and also of the tonsils are fairly common. Of 1,124 cases of extragenital chancres collected by Fournier, 847 were

Figs. 1 and 2—Recurrent papulo-ulcerative syphilides. This is an interesting case depicting two recurrent lesions in the same patient, which occurred at different times but always retained the same character. The disease was contracted one year previously. The chancre was of the ulcerative type. The patient had a full course of arseno-benzene and mercury, but while still under treatment with mercury, recurrent ulcerative lesions appeared on the shoulders. Later the chancre broke down again, and still later an ulcerative papule appeared on the arm (Fig. 1) and on the tonsil (Fig. 2).*

Fig. 3—Primary sore on the upper lip. Note the typical infiltrative edema of the surrounding mucous membrane. The submaxillary lymphatic adenitis was, as is usual, pronounced in this case. Macrocheilia (abnormal or excessive size of the lips), as a recurrent syphilitic manifestation, appeared three years later.*

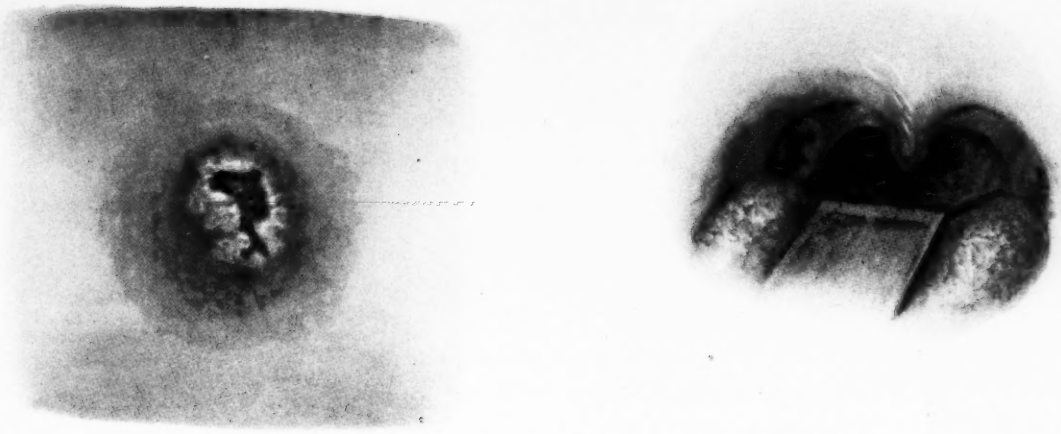
Fig. 4—A healing primary sore on the thumb. One week after the thumb became sore a chancre began to develop on the glans penis. The generalization stage in this patient was particularly severe. Suppurative lymphatic adenitis more commonly follows extragenital than genital chancres.*

Fig. 5—So-called snail track appearance of mucous patches on the palate.*

Fig. 6—Gummatous ulceration following a parenchymatous glossitis affecting the anterior two thirds of the tongue. This type of case frequently fails to respond to arseno-benzene and mercury; indeed, metals may aggravate the condition. Intramine (diortho-amino-thiobenzene) is particularly indicated.*

NOTE: *Reproduced by permission of the C. V. Mosby Company, St. Louis, Missouri, from the book "Venereal Diseases: Their Clinical Aspect and Treatment" by J. E. R. McDonagh. Our figures 1 through 8 inclusive represent numbers 56, 57, 78, 79, 81, 82, 83, and 84 in this book.

*From the Division of Medical Measures, American Social Hygiene Association, New York. This article was especially prepared for publication in THE DENTAL DIGEST.



Figs. 1 and 2—Recurrent papulo-ulcerative syphilides

Fig. 3—Primary sore on the upper lip

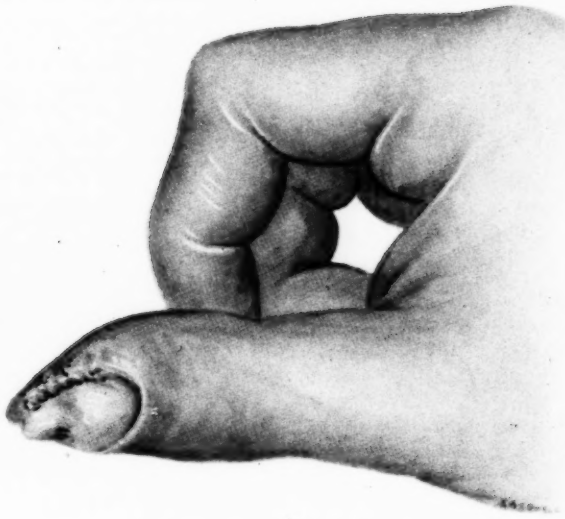


Fig. 4—A healing primary sore on the thumb

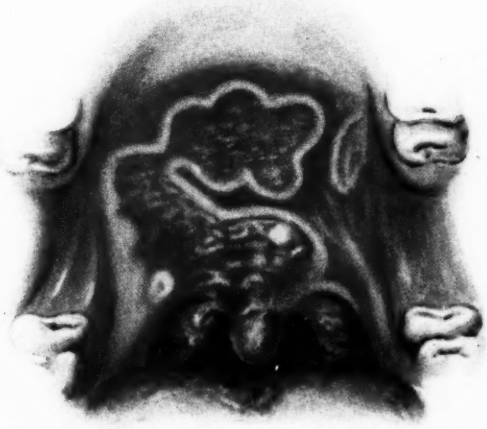


Fig. 5—So-called snail track appearance of mucous patches on the palate*

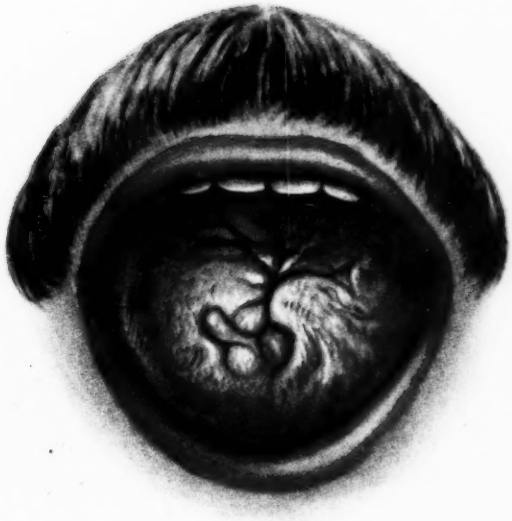


Fig. 6—Gummatous ulceration following a parenchymatous glossitis

Fig. 7—Syphilitic glossitis before the administration of intramine

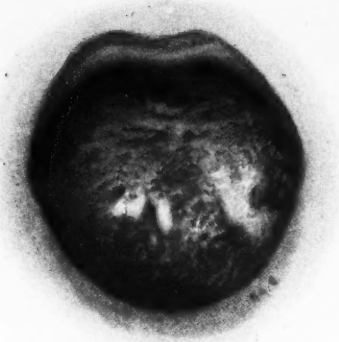


Fig. 8—Syphilitic glossitis one week after the administration of 2.5 cm. intramine

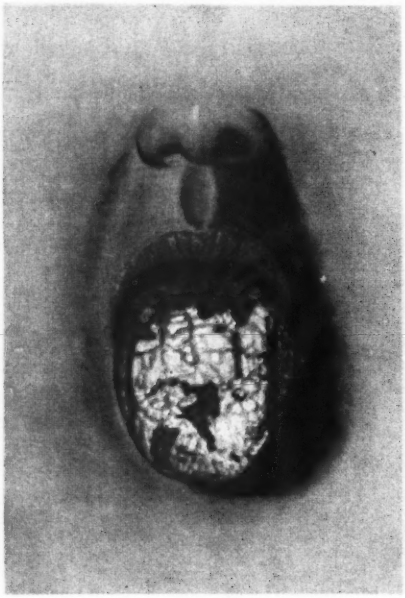


Fig. 9—Chronic glossitis with advanced sclerosis

Fig. 10—Syphilitic psoriasis of the tongue**

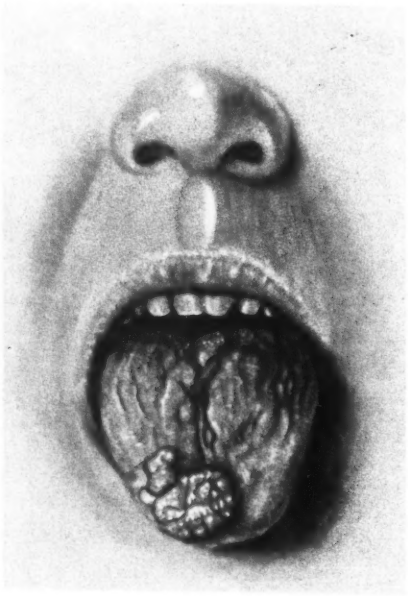


Fig. 11—Atrophic sclerosis with precancerous papillomata**

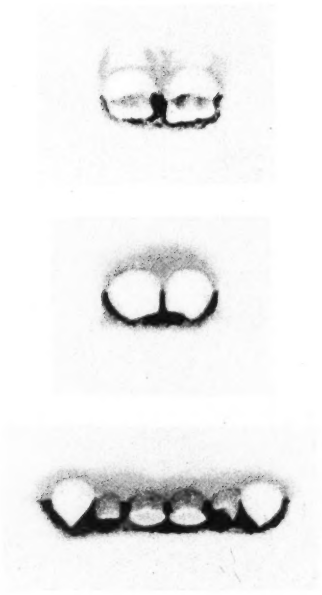


Fig. 12—Hutchinson's Teeth**

Fig. 7—Syphilitic glossitis before the administration of intramine. Syphilis was contracted forty years before and the tongue became affected ten years ago. Note the ulcer and that the tongue cannot be protruded.*

Fig. 8—Syphilitic glossitis one week after the administration of 2.5 cm. intramine injected into each buttock, no other treatment having been prescribed. Note that the ulcer has healed and that the tongue can be protruded.*

Fig. 9—"Chronic glossitis with advanced sclerosis (the 'White Paint Patch').** The patient was a man in good health who had formerly suffered from syphilis and who had smoked heavily. The conditions shown had been slowly advancing for many years. A dense, firmly-adherent white coating with well-defined edges covered the anterior two-thirds of the upper surface. At the sides and on exposed portions there were abrasions and large, firm papillary growths. These probably represented the fungiform papillæ; the filiform had long been lost."

Fig. 10—"Syphilitic psoriasis of the tongue.** The conditions here shown occurred in the third month of syphilis and were coincident with an abundant papuloscaly eruption on the skin. The patient was a surgeon, and the infection had been acquired in midwifery practice. In addition to the eruption he had sore throat with laryngeal hoarseness and deafness in one ear. He was treated by grain doses of grey powder three times daily and was salivated. The patches on the tongue disappeared very quickly, and a few months later not a trace of them could be detected. It will be observed that the patches are arranged with bilateral symmetry, although not of equal size on the two sides."

Fig. 11—"Atrophic sclerosis with precancerous papillomata.** The patient was a smoker who had long ago suffered from syphilis. His tongue had given him but little trouble, but had been slowly passing into its present condition for many years. The surface of the tongue is seen to be destitute of papillæ in parts, smooth, and of an opaque white tint from superficial sclerosis. In other parts it shows lumpy hypertrophy, and the central furrow is exaggerated. Near to the tip, and again in mid-dorsum posteriorly, are some firm papillomata, the bases of which are constricted . . . After several operations the man ultimately died of epithelial cancer of the submaxillary glands."

Fig. 12—Hutchinson's teeth.** A, "A pair of 'craggy' teeth: they are the upper central incisors and may be contrasted with Fig. 2 (B in our legends). These craggy teeth appear to be sometimes a family peculiarity, and to have no connection with either syphilis or mercurialism." B, "A pair of typical teeth: they are the upper central incisors of the permanent set. These are dwarfed in all dimensions, slant towards each other, are of screwdriver form, and show shallow central notches." C, "The upper milk teeth of a syphilitic child aged three years. The lateral incisors have been left as mere stumps by the breaking away of their crowns, and the two central ones are progressing to a similar condition through erosive caries which encircles their shafts. The canines are large and their enamel is sound."

**Reproduced by permission of Funk & Wagnalls Company, New York, from the book "Syphilis" by Sir Jonathan Hutchinson. Our figures 9 through 12 inclusive represent Plates 1, 14, 16, and 31 of this book.

in the region of the head, mostly about the lips. In 9,058 extragenital infections, Bulkley found the tonsils sixth in frequency as the site of infection, and the tonsils and throat together as fourth in frequency, being exceeded only by the lips, breasts, and nipples.

Much more frequent than the appearance of these primary syphilitic lesions in the area of the dentist's operations are the highly contagious lesions of the mucous membrane of the mouth and throat as a manifestation of the secondary stage of syphilis, appearing commonly along with the characteristic skin eruptions. The buccal cavity provides an ideal culture ground for the causal organism, furnishing constantly the moisture and heat required by it. Less frequent is the appearance of the less infectious tertiary destructive lesions of the gummatous type.

Syphilis is a systemic disease caused by the *Spirochaeta pallida*. From the local site of infection the organisms travel through the lymph channels to the blood stream and there results a generalized spirochetemia. The disease may attack any and every organ or tissue of the body, simulating in its varied manifestations most of the known diseases and hence largely confusing the issues of diagnosis and treatment. Syphilis has been called "the great imitator," and "the great killer." The disease presents one of the most pitiful tragedies of life in that it may be transmitted to the child in utero. Without timely treatment in pregnancy almost all syphilitic mothers transmit the disease to the child before birth, causing stillbirth, early infant death, or syphilitically crippled and defective children. With timely treatment in pregnancy such transmission of the disease can be almost wholly prevented. The late killing lesions of the disease emphasize the need of early treatment for their prevention. It is estimated that in every 1,000 syphilitic patients, forty develop general paralysis of the insane; twenty, tabes dorsalis; and 160 will meet sudden death from heart and blood vessel conditions.

In acquired syphilis the initial lesion appears from ten days to ten weeks after exposure at the site of attack of the spirochete. The lesion begins as a small vesicle or papule or merely as a red spot which gradually becomes a papule. As the vesicle or papule increases in size, erosion takes place, forming an ulcer with a rather sharply defined regular margin. The ulcer becomes indurated at its base, the induration extending into the surrounding tissues. A pink areola may surround the area of the ulcer. Usually, though not always, chancres are single, and unless pyogenic infection is superadded, the lesion is painless.

The commonest site of the chancre is, of course, the genital area. It appears, however, not infrequently in other parts of the body, especially on the lips or within the mouth. In these areas they may become a concern of the dentist. The diagnosis on clinical evidence alone is not easy, for non-syphilitic lesions may closely simulate the chancre and the picture of the latter may become confused by mixed infection. An indolent, painless lesion as described, associated with a painless enlargement of the adjacent lymph glands, must strongly suggest syphilis, and calls for a laboratory diagnostic test.

Usually in a period of six to ten weeks following infection the characteristic skin eruptions appear. These early eruptions are generalized and symmetrical in distribution. In cases in which the eruptions appear late, they may in some cases be so inconspicuous and transient as to escape the patient's notice.

Characteristic Appearance of Lesions

Any detailed discussion of the varied appearances of the syphilitic skin eruptions is beyond the scope of this article. The early eruptions appear in the following characteristic forms:

1. *Macular syphilides*—The first appearance may be a roseolar rash, a faint rose colored flush. At other times the circular spots may be the deeper, coppery red of the macular syphilides. The rash becomes generalized over the trunk and at times appears on the palms of the hands and soles of the feet. Syphilitic skin eruptions rarely appear on the backs of the hands.

2. *Papular syphilides*—Through a process of induration, which is apparent to the touch, the macules may become transformed into papules, or the eruption may begin in the papular form. The papules are circular in form and are of the coppery color distinctive of syphilis. They have a tendency to desquamate, and they may be distinct or confluent.

3. *Pustular syphilides*—Through a process of necrosis the papule may become a pustule. The shape is circular and it has the indurated base. The pustular eruption is usually mingled with the papular, presenting a papulo-pustular condition.

As a result of more extensive necrosis of central tissues there may result

the formation of the large, crusted, ulcerated sores of syphilitic rupia.

One of the most valuable diagnostic points, characteristic of syphilis only, is that roseoles, macules, papules, and pustules may be found at the same time. There are many variations of the types described. Certain characteristic features help, however, to distinguish syphilitic eruptions from other skin lesions: dull red or raw ham color; induration, except in the roseolar form; bilateral, symmetrical distribution; initially circular in shape and often discrete; no pain or itching. When skin eruptions of syphilis appear the Wassermann reaction is practically always positive. In practically all cases there will be other evidences of syphilis, such as an initial sore on the genital organs, adenitis, and lesions on the mucous membranes.

It is well for the dentist to be familiar with at least the typical manifestations of syphilitic skin lesions, even though his opportunity for observation is necessarily limited to the areas of the neck, head, and hands where they are not always manifest. When suggestive lesions of the mucous membrane appear, one should look for confirmation in skin lesion.

When the earlier skin lesions are not treated they may disappear for a time and then reappear again and again until treatment is given. The later eruptions are more varied in types.

The syphilitic lesions appearing on the mucous membranes and mucocutaneous junctions are of particular importance to the dentist since their frequent sites are the mucous membranes of the mouth and the angles of the mouth and nose. The generalized infection may manifest itself in these locations as early or even earlier than skin eruptions. The papules appearing at the mucocutaneous junctions tend to hypertrophy and at times to warty growth. Indurated, painless lesions in these locations must be regarded with suspicion of syphilis.

The mucous areas that show early or late manifestations of syphilis are the inner aspect of the lips, buccal mucous membrane, hard and soft palate, tonsils, and tongue. The early manifestations are the *mucous patch* or the *moist papule,* and it is these that the dentist must be particularly ready to detect. They are commonly a feature of the secondary manifestations of syphilis, and they are highly infectious lesions. The concise description given by Lees[1] is worth quoting: "The mucous patch is circular in outline, of varying size, and has a raised milky translucent flat surface surrounded by a narrow red edge. The mucous patch does not give rise to any great induration. It is situated most frequently on the inner aspect of the lips or on the fauces. It is raised slightly above the surface, which is denuded of epithelium, and the greyish-white secretion on its surface shows on examination large numbers of *Spirochaeta pallida.* At times it may break down and give rise to an ulcerated lesion which, because of irritation or uncleanliness of mouth, becomes slightly indurated."

The *moist papule* is another common early manifestation of syphilis on the mucous membranes of the mouth and throat. It is similar to the papule that appears on the skin, having a somewhat indurated base and raised border. By erosion of its surface the papule may become an ulcer.

The late syphilitic lesions that occur in the mouth are chiefly gummatous in type. The gumma begins as a subcutaneous or submucous nodule. It may break down and ulcerate to the surface, the ulcer presenting a punched out edge and a gray sloughing floor. At the beginning they are almost always painless. The tongue is the most frequent site. The tongue tends to become fissured, ulceration being rare.

Another late manifestation of syphilis in the mouth is *leukoplakia.* It appears as a round or oval patch with a thick, milky appearance of the mucous membrane. Under irritation the patches may become ulcerated.

The stigmas of congenital syphilis need only to be mentioned. Of those which are definitely pathognomonic of syphilis and which may be observed by the dentist are the notched upper central incisors; namely, Hutchinson's teeth, and the saddle nose; these are the scars of earlier syphilitic activity. When they are encountered the socially-minded dentist may seek tactfully to ascertain whether or not the condition is understood by those responsible for the child and is under competent medical observation or treatment, and to try to bring proper care about if it is not.

Conclusion

Some of the most typical manifestations of syphilis have been presented sketchily without complicating details. The dentist is not expected to be an expert diagnostician in syphilis. He should be familiar enough with its manifestations to sustain, not a morbid "syphilophobia," but a wholesome safeguarding attitude of suspicion in regard to lesions that may be syphilitic.

The problem of protecting himself and his patients from infection is comparatively simple for the dentist. So far as his patients are concerned, the habit of thoroughly sterilizing all instruments used on any patient, which in any case always should prevail in a dentist's practice, will suffice. For the dentist's own protection also only reasonable precautions are required. To be sure, a break in the skin of only microscopic proportions of which the dentist may not be aware is all that is needed for the spirochete to find entrance into the system. But the organism does not quickly penetrate into the lymphatics. In a really suggestive case, it is a wise precaution to work with rubber gloves if possible. During a long appointment, a washing of the hands with soap and water and the use of a germicidal solution at half-hour intervals, followed by a more painstaking process of disinfection at the close of the appointment may be relied upon.

The public health function of the dentist in this matter is a delicate one. He cannot expect to make a positive diagnosis without the aid of a Wassermann test or other recognized blood test. Even the syphilologist seldom relies upon clinical evidence alone. In the interest of the infected patient it is of the utmost importance that syphilis be diagnosed and treatment begun at the earliest possible moment. The fate of the patient hangs mainly on the length of the interval between infection and the beginning of treatment. In cases of late lesions not under treatment the urgency is only one of less degree.

The task of the dentist in suspected cases of syphilis is one of getting the patient tactfully into medical hands for a diagnostic blood test. This requires persistence and ingenuity. Naturally, except in rare cases of personal acquaintance, the dentist will not wish to, and cannot wisely, suggest a blood test for syphilis. His suggestions and advice must be cast in obscurity. He may, however, suggest the advisability of going to a physician for examination and suggest that the patient request a blood test as part of the examination. If the patient has a physician the dentist may explain that he would like to confer with him about the patient's general condition. In the dentist's natural hesitation to render such a service, he should not fail to visualize what is at stake in the life of the patient, and also of his family and other members of society whom he may infect.

[1] Lees, David: Practical Methods in Venereal Diseases, New York, William Wood & Co.

The Editor's Page

MR. HOWARD SCOTT, Director of the Energy Survey of North America, and his colleagues in the study at Columbia University, have within the past few months given the American public a subject for violent and interesting debate. Technocracy, in common with jig saw puzzles, is a current fad. But unlike most fads the contentions of the technocrats have more than fad substance; they are chock-full of serious and gloomy facts, some hopeful ones, and a bit of the bizarre. Although, since the Industrial Revolution, some economists have been writing that one day the machine would master man and supplant man-power, it was not until Mr. Scott popularized the term technocracy that the public became alarmed. In fact, it is unlikely that before the mournful autumn of 1929 any one would have paid much attention to a gloomy prophet.

Perhaps some of the arguments of technocracy are far-fetched and fantastic; however, these grim facts do stand out: Employment has been decreasing since 1918, whereas production in the decade between 1918 and 1928 steadily increased; and debts have been increasing faster than production. Along with the obvious fact that the machine is supplanting man-power in production technology, there are likewise three things set in conflict with the price system itself, say the technocrats[1]:

> 1. The mechanics of placing purchasing power in the hands of the consumer is the exchange of money for the consumer's time (or labor), and technology is reducing the total amount of time required.
>
> 2. The working of the price system has forced the manufacturer to reduce the total number employed rather than to distribute the amount of time required among the total number of available workers. Technology has now advanced to a point where it has substituted energy for man-hours on an equal basis and where the distribution of human labor becomes impossible.
>
> 3. Through increased investment in machines—made necessary by the increasing rate at which they go out of date—the manufacturer is forced to reduce the proportion of his costs which go to labor. This again inexorably works against the increase of wages and the distribution of time.

Although dentistry can never be done by automatons and machines, and dentists do not face the danger of technologic unemployment, we observe the increasing tendency toward the delegation of certain dental duties to non-dentists: to laboratory technicians, dental hygienists, dental assistants, for instance. In many cases this is economically sound and represents the efficiency that comes from the division of labor. Then, too, machines and instruments of precision—x-ray apparatus, articulators, casting machines—these have been developed to make the production of dentistry easier and more accurate.

In a previous issue of this journal[2] Doctor David W. Phillips described an automatic investing machine. In this issue the same author describes a simplified precision technique for gold inlays which is standardized from the spatulation of the investment to the pickling of the finished casting. Irrespective of the investing room temperature and without the use of the water bath this technique is successful. This method affords the "flexible link in the chain of inlay procedure to accommodate wax pattern dimensional variations when investing at different room temperatures." By the use of the "control powder" in the investment it is possible to accommodate for varying room temperatures under any and all seasonal and geographic conditions. Likewise, with this method, the investment expansion may be controlled for different types of castings.

If a development such as this scientifically accurate inlay technique, which is simpler, surer, cheaper than the old methods, is symbolic of technocracy, we should welcome this new economic era. If, on the other hand, technocracy means steadily rising debts and steadily falling employment, the leisure of despair rather than leisure for recreation and education, we have reason to fear the new era.

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[1]Technology Smashes the Price System, Harper's Magazine **166**:139 (January) 1933.

[2]Phillips, David W.: An Automatic Investing Machine, THE DENTAL DIGEST **38**:122 (April) 1932.

Fig. 1—Sutureless flap in the removal of an upper first molar where the roots are greatly divergent.

TECHNIQUE FOR A SUTURELESS FLAP IN DIFFICULT SINGLE EXTRACTIONS

GEORGE SCHNEIDER, D.D.S.
La Salle, Illinois

Fig. 2—Sutureless flap for the removal of an upper first bicuspid with greatly divergent roots. This technique allows the removal of either the first bicuspid or the first molar along the line of the long axis of the lingual root of either tooth without fracturing the roots or the buccal plate.

Often the general practitioner does not have enough regard for the soft tissue around the tooth socket, nor does he always fully realize the importance of preserving the soft tissue in all single extractions.

Every time an extraction is done and the patient is dismissed with some exposed bone tissue in that tooth socket there is a great deal of post-operative pain. There is more or less sloughing of both hard and soft tissues, thus retarding healing. In making a proper flap and removing from one third to two thirds of the buccal or labial cortical plate overlying the root of the tooth to be removed, one does not interfere with ridge formation. The ridge at the end of twelve months will be about the same as it would have been if the tooth had been extracted without removing any of the buccal or labial plate.

1. In the case of a lower bicuspid when the roentgenogram reveals that the root is hypercementosed and cannot be drawn up through the normal tooth socket, two incisions should be made. One incision should start at the neck of the disto-buccal angle of the tooth to be removed and extend to the disto-buccal fold, a distance equal to about one third of the crown end of the root of the tooth.

2. A similar incision is made from the mesial-buccal angle of the tooth to the mesial-buccal fold, care being taken not to touch the adjacent teeth.

3. The mucoperiosteal flap is laid back with a periosteal elevator. In making a flap, whether sutureless or otherwise, for a difficult single extraction, two factors must be kept in mind: first, there must be plenty of blood supply to the flap; second, there must be sufficient bone tissue for the flap to rest on when put back in place.

Fig. 3

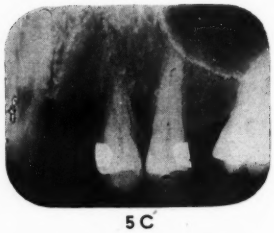
Fig. 3—Condition of tooth socket forty-eight hours after the removal of an upper first molar by the sutureless flap technique.

Fig. 4 — Condition of tooth socket twenty - four hours after the removal of an upper first bicuspid by the sutureless flap technique.

Fig. 4

5 A

5 B



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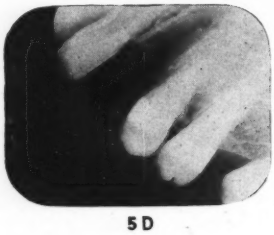

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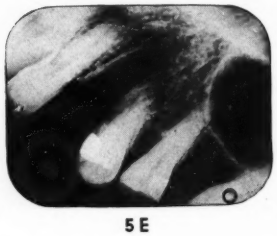
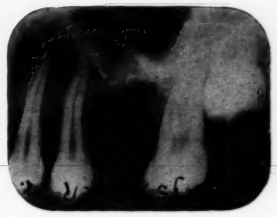


5 E

Fig. 5—A, Condition of bone tissue forty-five days after the removal of an upper right cuspid in a patient, aged 50. About one half of the buccal plate overlying the root of the tooth had been removed prior to the extraction; B, appearance 105 days after extraction. Note filling in of bone tissue from the apex of socket and from the wall to the center of the socket; C, appearance 137 days after extraction. Note the continuation of filling in of bone tissue; D, appearance, 168 days after extraction. Note continuation of bone change; E, appearance 200 days after extraction.

(*See next page*)

6A



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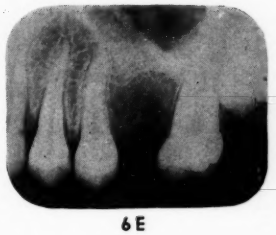

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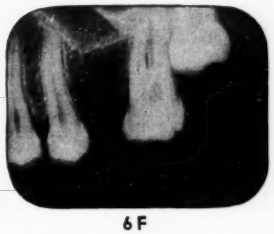


6F

Fig. 6—A, condition of bone tissue thirty-four days after the removal of an upper left first molar by the sutureless flap technique, in a patient, aged 20, after about one half of the buccal plate overlying the buccal roots had been removed. B, Sixty-four days after the removal of the tooth. Note the change of bone tissue. C, Ninety-four days after the removal. Note change in bone tissue and also note the second molar being pushed forward by the eruption of the third molar; D, appearance 124 days after the removal; E, condition 154 days after the removal; F, condition 293 days after the removal. Note how nicely the bone tissue has filled in.

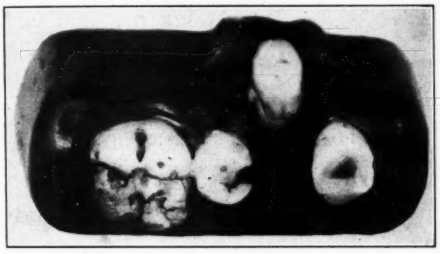


Fig. 7

Fig. 7—Removal of a lower first bicuspid with hypercementosed root. The proper mucoperiosteal flap is made; the buccal cortical plate overlying the root is removed down to a point just below the widest point of the hypercementosed portion of the root; the tooth is forced to the buccal then, up and out.

8A

8B

8C

Fig. 8—A, (top), Appearance of ridge twenty-eight days after the removal of an upper left first molar by the sutureless flap technique; B, (center), appearance 251 days after the removal of the tooth. Note ridge formation; C, (bottom), Note ridge formation after the removal of upper left first and second bicuspids under forceps extraction without a flap.

9A

9B

Fig. 9—Same case shown in Fig. 5. A, (top), Condition of ridge fifteen days after the removal of an upper cuspid by the sutureless flap technique in a patient, aged 50. B, (bottom), Appearance 230 days after the removal. Note ridge formation.

Fig. 10

Fig. 10—Ridge formation after the removal of an upper right cuspid under forceps extraction. Note that the ridge formation is about the same as in Fig. 9, B.

A SCIENTIFICALLY CORRECT INLAY TECHNIQUE

DAVID W. PHILLIPS, D.D.S.
Chicago

DELICATELY precise castings can be made today entirely irrespective of investing room temperatures, without recourse to the water immersion bath, and with a completely standardized procedure from spatulation to pickling, even to the point of casting at a constant mold temperature. Impossible? "The only difference between the difficult and the impossible is that the impossible takes a little more time." The impossible takes time, but the current degree of prosperity bountifully furnishes it. In the evolution of the casting art, magic and hokum have been rampant; but today there is a definite trend toward a more scientific approach based on accurate data concerning the physical properties of the materials employed. The use of small castings for inlays and bridgework has increased so tremendously in the last few years, and the scope of their practical application has so broadened that today this branch of dentistry ranks in importance second to none. Constant improvement in methods and materials over a period of years has resulted in precise casting, but the procedure has not yet become sufficiently refined to achieve the desideratum without employing more or less elaborate technique. Heretofore, exactitude in casting has depended too much on the skill of the individual technician.

What is needed today, in this connection, above all else, is a precision technique so automatic and so simple that it can be advantageously employed by any dentist or assistant. The advent of Cristobalite (originally the product of research in the National Bureau of Standards) makes such a technique possible, but not unless the present insufficient methods of employing this material are radically, though rationally, improved, will the requirements of both precision and simplicity be reconciled.

Many have believed that the mere introduction of a superexpanding investment, such as Cristobalite, would solve all casting problems and that one could then take all good wax patterns, invest each in the same manner but at varying temperatures, and, using the same technique throughout in each case, always obtain a precise result. Unfortunately, this is physically impossible. Cristobalite, however, does provide the maximum thermal expansion, which makes possible an easy new method for obtaining the utmost in precise casting results.

Physical Phenomena Involved in Casting

The high coefficient of expansion of inlay waxes is a matter of common knowledge. A comparatively small rise in temperature effects a considerable expansion in a wax pattern; likewise, an equivalent drop in temperature produces a correspondingly large shrinkage. When the pattern is removed from the tooth in the warm mouth and cools to average room temperature (from 70 to 75° F.), it undergoes a considerable shrinkage, estimated[1] at about 0.5 per cent. If this pattern is invested at ordinary room temperatures it must be remembered that a pattern is being invested which has shrunk in size as it has cooled after removal from the mouth. The object is to produce as nearly perfect a counterpart of the cavity as possible, and not to duplicate the wax pattern that is being invested at an average room temperature.

Van Horn[2] has pointed out that: "1. Open mouth temperature is not room temperature unless room temperature happens to be at least 95° F. 2. Wax patterns cannot be fitted at room temperature to cavity details in a tooth *in situ*." The shrinkage of gold, the familiar 1.25 per cent, appears constantly in dental literature and dental advertisements, but when the compensating expansion necessary in an investment to balance the shrinkages is figured, it must be remembered that the wax shrinkage that occurs when the pattern cools to room temperature is just as important a factor as is gold shrinkage, and must be added to the shrinkage of gold.

One must admit and contend with the high thermal expansive properties of inlay waxes, and compensate for and balance varying degrees of expansion and shrinkage in the wax pattern as it cools to varying room temperatures. Cristobalite fully compensates for gold shrinkage, and in addition, the shrinkage of the pattern, cooled on the removal from the mouth to average room temperature. But there are days, months in fact, of much higher room temperatures in the dental laboratory, when one invests a pattern that is at a higher temperature than average room temperature, and that instead of having shrunk from mouth temperature to about 72° F. when invested has shrunk only from mouth temperature to 80°, 90° F., or, under conditions of extremely warm room temperature, possibly has not shrunk at all; then there will be far less wax shrinkage for which to compensate, or possibly none at all. If the same amount of investment expansion is employed, the result will be an inlay too large for the cavity, or one overexpanded.

If a certain technique produces exact results when investing a pattern at 72° F., when the room temperature rises 10°, 20°, 30°, or even more, as it often does, the same technique employed with the warmer expanded wax pattern would result in overexpansion, with its trail of broken cusps, poor fits, and "malletted" gold inlays. A technique to be correct must be as consistently usable in Florida as in Minnesota.

Nearly two years ago Taylor and Paffenbarger[3] were alert to two important factors herein discussed when they stated: "We have pointed out that if the pattern is made by the direct method, its adaptation temperature will be about 36° C. (96.8° F.). If made by the indirect method, it will be at *room temperature, which may be from* 20 *C.* (68 *F.*) *to* 40 *C.* (104 *F.*), *according to the climate and season.*" (*Italics mine*) Obviously, they would apply the same reasoning to the new approach permitted by the superexpanding investment materials. Novelty is not

[1] Volland, R. H. and Paffenbarger, G. C.: Gold Inlay Technique as Worked Out in the Cooperative Research at the National Bureau of Standards and Applied by a Group of Practicing Dentists, J. A. D. A. **19**:186 (February) 1932.

[2] Van Horn, C. S.: Pattern Waxes and Their Manipulation in Cast Gold Inlay Technique, J. A. D. A. **18**:486 (March) 1931.

[3] Taylor, N. O. and Paffenbarger, G. C.: A Survey of Current Inlay Casting Technics, J. A. D. A. **17**:2068 (November) 1930.

claimed in the consideration of the wax shrinkage variable. A definite control of investment expansion is absolutely necessary to strike a constant correct compensating balance between gold and wax shrinkage on the one hand, and investment expansion on the other, to combat effectively the danger of overexpansion, if the pattern is to be invested at any prevailing room temperature. Mathematically stated, the theoretical formula is:

INVESTMENT EXPANSION (SETTING AND THERMAL) = GOLD SHRINKAGE CONSTANT + WAX.

Shrinkage Variable

Because *no wax expansion* is being employed, and because the primary concern now is with *varying degrees of wax shrinkage* as the pattern cools on removal from the mouth to any prevailing investing temperature, the term *wax shrinkage variable* is suggested to designate the reversed dimensional change in the wax pattern in the consideration of the wax variable from the new standpoint.

There must still be some flexible link in the chain of inlay procedure to accommodate wax pattern dimensional variations when investing at different room temperatures. The water immersion bath provided this link by establishing the wax variable as a constant, and acted as a stabilizer which maintained the wax temperature at a certain fixed point where expansions and shrinkages were always correctly balanced. To compensate for the obvious variables, the prevailing room temperature and the relative pattern dimensions, and to effect expansion reduction or increase in the investment at will for any other purpose, an exceedingly simple and precise method of investment expansion control, requiring neither time, skill, nor "technique," will be presented later in this article.

Fig. 1 — Uniformity of thermal expansion within the mold. All the castings fit the die uniformly. All four patterns were invested at once, by machine, in seventy seconds.

No matter how nearly perfect and precise results of other methods and materials have been, the procedure must be changed to obtain the same degree of accuracy when working with Cristobalite. In fact, it can almost be said that the more exacting the technique has been heretofore, the greater will have to be the change to adjust to the simpler methods made possible by this superexpanding investment.

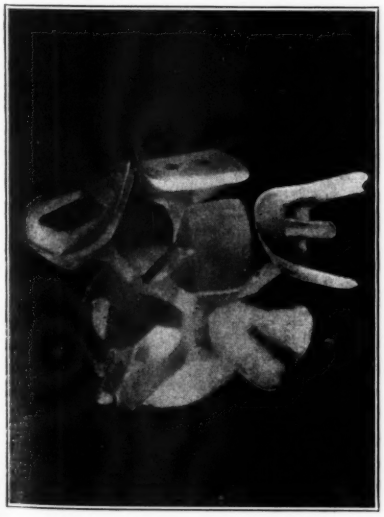
Cristobalite: Advantages and Cautions

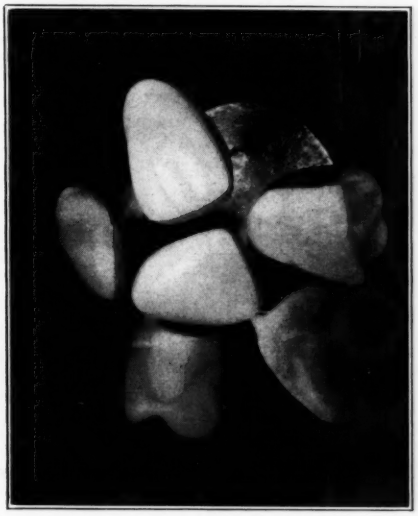
One of the favorable characteristics of Cristobalite is that it compensates for shrinkages, mainly by its thermal expansion. This is probably the most uniform and reliable type of compensatory expansion and is least likely to produce distortion; also, it greatly simplifies working to a mechanical nicety. When reheated, as in the water bath, wax evidences the insidious property of distortion; in other words, a wax pattern, taken in the mouth, permitted to cool to average room temperature, and reheated, will expand to its original size, *but it will not return to absolutely its original shape or form.* This distortion is due to the release of tensions within the wax pattern as the temperature is raised. When a superexpanding investment is used there is no need for artificial wax expansion in any guise. Thus, *pattern distortion is minimized.*

In a discussion of the advantages of Cristobalite in compensating primarily by thermal expansion, one might inquire why this kind of expansion possesses such a degree of uniformity. The even expansion within the entire mold is due to the fact that it occurs in every conceivable plane, in every imaginable diagonal as well as in the vertical and horizontal. When thermal expansion takes place, the distance between every molecule within the investment and every other molecule is increased. Such a conception facilitates understanding of the mechanics of this phenomenon and its practical application.

Results from experiments with the standard 2 per cent taper metal M. O. D. dies bear out this point. Repeatedly, four patterns for these dies and as many as six backings for tube and other types of porcelain pontics have been invested at the same time by machine[4] in all possible posi-

[4]Phillips, David W.: An Automatic Investing Machine, Dental Digest **38**:122 (April) 1932.





Figs. 2 and 3—These six backings for various types of porcelain pontics were simultaneously invested in the mold by machine. They were cast with the same button of gold. All went to place uniformly with finger pressure.

tions within the mold, some at the center of the mold and some close to the periphery, at various angles and in varying proximities to one another, some almost touching and others in more isolated positions. Notwithstanding, the fit of each casting on the metal die was always the same regardless of the number invested, or their positions in the mold, thus demonstrating the uniformity of thermal expansion in every part of the investment. The experiments also indicate that the same degree of precision can be attained in casting, whether one pattern is invested, or several in any position at one time in the same mix of investment.

Cristobalite possesses the ideal total expansion to which dentists have long looked forward and meets all requirements from that standpoint. Heretofore, the problem has been to increase the expansive properties of an investment to the point where the combined setting and thermal expansion of the investment alone would always fully compensate for the shrinkage of the wax pattern, when permitted to cool to ordinary room temperature, and for gold shrinkage in addition.

There are conditions, however, which prohibit the full use of this large expansion of the investment, and, in many instances, the expansion must be reduced. Not only must there be a reduction in expansion effected to offset the decreased wax shrinkage at high investing temperatures, but there should be, also, a simple and accurate means of expansion control whereby the investment expansion can be regulated to the exact extent desired for different types of castings.

The use of Cristobalite without some definite means of controlling and reducing its expansion frequently results in overexpansion. This is probably the greatest source of danger in the use of a superexpanding investment. It is a serious type of casting error. In fact, except in full crown restorations, a slight underexpansion is usually less objectionable. In some castings, such as M. O. D.'s for bicuspids, or three-quarter crowns, to increase slightly the grip of the casting on the tooth, I prefer a minute degree of underexpansion.

In calling attention to some of the dangers in the use of the investment under discussion, the sole purpose is to help the uninitiated immediately to realize the fullest possibilities of this product, with the minimum of failures. Any disadvantageous properties will be enumerated with a constructive purpose, and a simple and novel expedient will be described which will eliminate dangers of any undesirable consequence in the use of this investment. Actually, a powerful agent has been placed in the hands of a profession not entirely prepared to harness its potentialities, and there has not been sufficient educational background to prepare all dentists to reap the maximum benefit of, or even to do justice to, this new investment.

The second danger in the use of Cristobalite is its marked tendency to fracture, unless great care is observed during burnout. Burnout, in accordance with the manufacturer's instructions, requires almost an hour if cracking is to be avoided.

The probable explanation of the cause of fracture, when the investment is burned out quickly, is that the outer layers nearest the flame or electric coils expand a great deal more than the cooler parts deeper within the mold. This uneven expansion in different parts of the mold induces fracture. By the slow application of heat, time is allowed for the gradual conduction of heat to the interior of the mold so that there is a smaller temperature differential between the superficial and deeper parts of the investment within the ring, and more uniform expansion of the mass as a whole takes place.

All the moisture throughout the mold should first be eliminated by low heat for about twenty-five minutes before any considerable rise in the burnout temperature is permitted. When the mold has been completely dried there is no moisture in the deeper parts where the generation of steam will still prevent the internal temperature from rising as quickly as in the drier superficial parts of the mold. A thorough drying at low heat permits maintenance of more uniform temperature and expansion within the entire mold, and prevents fractures caused by differences in expansion in the superficial and deeper parts. When the mold has been completely dried, somewhat more rapid heat application is permissible because there is no restraining influence in the core to prevent internal temperatures from rising just as rapidly as the superficial temperatures, except the inherent insulating properties of the material itself. It must be admitted, however, that doubling the time required for burnout is no advantage. Incidentally, the control method to be described, when applied, materially reduces friability of the investment and even permits much more rapid burnout.

A seeming uniformity of fineness of the refractory element and a comparatively lower proportion of binder materials, with accompanying reduction in crushing strength, especially when heated, are undoubtedly contributing factors to fracture and flaking tendencies. Much more care must be exercised in burning out Cristobalite investment, but fracture can be avoided if directions are carefully followed.

The directions on the container call for a 38-42:100 water-plaster ratio; that is, from 38 to 42 cc. of water to 100 Gm. of investment powder. The use of more than 40 cc. of water produces a thin mix and a weak investment with reduced crushing strength and is an injustice to a good product. When the larger proportion of water is driven off in the burnout the investment is less dense and the full possibilities of fine smooth castings are not fully realized.

A somewhat thicker mix (38:100 water-plaster ratio), made by using a little less water, is less fragile, and always preferable, especially with this material, which is not too hard nor too strong after burnout when used alone.

Cristobalite flakes rather easily during burnout and one must be a little more careful to see that the little pieces that flake off near the ring do not drop into the sprue hole. Handling the mold inverted whenever possible largely obviates this difficulty.

The asbestos liner placed within the ring is essential to facilitate full radial expansion of the investment within the ring. Without the cushioning effect of the liner, setting expansion cannot be utilized in the horizontal plane. Also, the thermal expansion of this investment exceeds the thermal expansion of the enveloping ring so that the liner must be used to absorb the excess expansion within the investment. Without the liner, distortion would result.

The split ring, the expanding ring, and the paper ring can be used in place of the asbestos liner if one wishes to produce the same or a somewhat similar result in a manner that requires more technique, time, or work.

The double mix of investment is unnecessary; in fact, it has been superfluous for some time because of the quality of investments available.

Cristobalite is ideal for machine investment because the single mix used in mechanical investment is the one best suited for this superexpanding investment. The consistency best adapted to the use of Cristobalite, whether creamy or fairly thick, is especially suitable for precise machine work.

Present Means of Expansion Control

It is evident, then, that some kind of expansion regulation of this investment is absolutely necessary. The following are some of the possible means of effecting this control, and certain obvious disadvantages are noted:

1. *Thinning the Mix* — This is probably the least desirable method with which to attempt expansion control. Reducing expansion by the use of excessive amounts of water weakens the investment, reduces its density and crushing strength, produces rougher castings, and prohibits exact casting results over the possible room-temperature range. The mix must *not* be made thinner to reduce expansion of the investment.

2. *Casting at Different Degrees of Mold Temperature*—Cristobalite has an interesting thermal expansion curve. It rises sharply from about 380° F. to over 500° F.; thereafter, the rise is much more gradual until 1650° F. is reached. This characteristic is of great value in a practical way, indicating that in the red heat range one can cast at almost any point with a relatively negligible dimensional change in the casting. This favorable property[5] was demonstrated in an experiment showing five castings for M. O. D. dies made at 180° intervals from 930° to 1650° F. The illustrations indicated surprising uniformity of fit.

Now, if one tries to regulate the expansion of castings with any degree of accuracy by casting at different mold temperatures, he is attempting to do something practically impossible without precision burnout equipment. The thermal expansion curve of Cristobalite, unlike those of other inlay investments, ascends almost vertically in the lower casting-temperature ranges to about 600° F., indicating that comparatively small changes in casting temperatures up to that point will produce large variations in the expansion of the investment and in the size of the castings.

The thermal expansion curve of Cristobalite also reveals that there is almost seven tenths of 1 per cent expansion in a temperature rise of a little more than 100° starting at 380° F., and of less than one tenth of 1 per cent in a temperature rise of 400° beginning at 1000° F. In other words, there is about twenty-five times as much expansion variation per degree in the more nearly vertical part of the curve than in the flatter part in the high-heat range.

In order to gain precision under different investing-temperature conditions, by reducing the thermal expansion of the investment each time to just the point desired, an operator would have to cast one time at one temperature and another time at another temperature; and, furthermore, he would have to cast within the temperature range where exactness is absolutely necessary, because of the large variations in expansion within a comparatively small temperature range. To accomplish this with accuracy he must be equipped with a pyrometer furnace. The manufacturer of Cristobalite states, in the directions accompanying the investment: "An oven which has no rheostat, three-heat switch, or thermometer cannot be depended on to give consistently satisfactory results. *You must be able to control the heat.*"

In the event the operator were slow about heating his gold when casting under 600° F., a temperature drop would produce a shrinkage in the casting many times as great as a similar drop would cause at red heat.

To place the ring over a Bunsen burner and cast below red heat is slipshod at best. It is almost as easy to tell the contents of a paper bag by the bulges as it is to guess whether the temperature of the mold is 380° or 500° F. Yet this comparatively small difference in the temperature, at this point in the thermal expansion curve, produces castings that vary nearly 0.7 per cent in expansion.

It is important that one avoid casting in the temperature range included in the "vertical" part of the thermal expansion curve and that one cast instead at temperatures encompassed in the flatter part of the curve, in the high-heat range where there is less variation in the thermal expansion.

3. *Use of Cold Water for Investment and Cooling the Bowl, Spatulator, Ring*—To attempt expansion reduction by the use of cold water not only is a nuisance, but is entirely unreliable. Who is clever enough accurately to anticipate the degree of cooling of materials and apparatus necessary at various room temperatures to produce in the pattern and surrounding investment the hoped-for, predetermined temperature when the investment shall have set? One cannot wrestle with casting problems under the "guess as guess can" rules.

4. *Cold Water Immersion Bath*—The unnecessary water bath again; this time cold instead of hot! Besides, for the cold water bath to be effective, the set of this investment would have to be retarded in order to make certain that the temperature of the pattern would be lowered to that of the surrounding water before the investment set.

Each of the foregoing methods is inadequate and fails to make accuracy compatible with simplicity. Either the physical properties of the investment are impaired without attaining the desired result (thin mix), too careful employment of precision burnout equipment is necessary (lowered and varied casting temperatures), or the skill of a Houdini is required (cooling materials and apparatus). Furthermore, all introduce unnecessary "technique."

Also, not one of the methods mentioned improves in any way a single physical property of this investment material, and none helps overcome any disadvantageous working quality. Strangely enough, both of these desirable ends can be accomplished when a simple and certain method of expansion control is applied which permits identical procedure always to be followed under all conditions from and including spatulation of the investment to the finished inlay.

Automatic Expansion Regulation by Use of a Control Powder

Experience indicates that when a wax pattern is made in the mouth and invested with Cristobalite alone in a room temperature of 60° F., with water, investment, and all equipment at that prevailing room temperature, the precision desired is obtained for average practical inlay work, when casting into the usual red-heat mold.

Now, if the investing room temperature is 70° F., instead of 60° F., then the pattern is at a temperature 10° higher and, of course, slightly expanded. If the pattern is invested at this somewhat higher room temperature, and the identical investing and casting procedures are carried out, some overexpansion will result in the casting, equivalent to the wax expansion that takes place in a temperature rise from 60° to 70° F.

As the investing room temperature and pattern temperature reach 80°, 90°, or even 100° F., tremendous overexpansion of the pattern will result if the same investing and casting techniques are followed. As the wax pattern expands, less compensatory investment expansion is required.

To offset the wax expansion at a given room temperature higher than 60° F., a certain and definite proportion of expansion "control powder" is introduced with the Cristobalite so that the thermal expansion of the resulting investment admixture will always be reduced an amount equivalent to the expansion of the wax pat-

[5]Footnote 1, page 197.

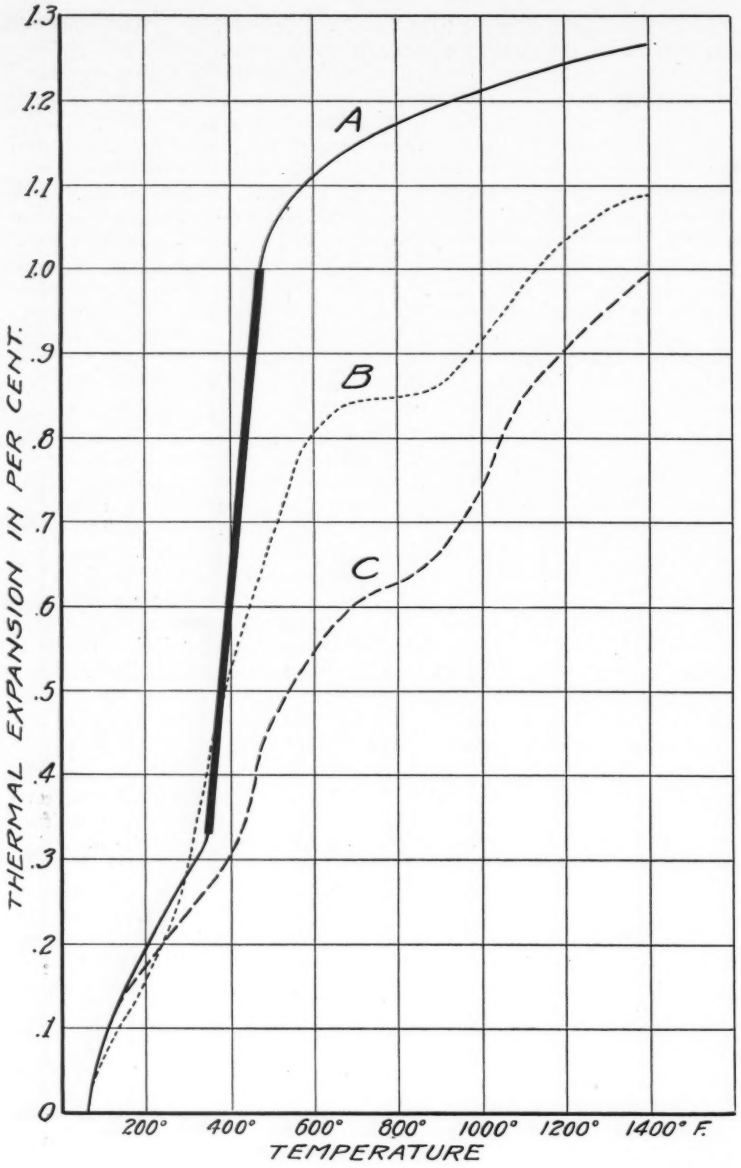


Fig. 4—A, Thermal expansion curve of Cristobalite used alone; B, thermal expansion curve of an admixture with control powder for investing patterns at 75° F.; C, thermal expansion curve of an admixture for investing at 85° F.

Note the extraordinary increase in the thermal expansion curve of straight Cristobalite beginning at about 380° F., identified as the heavier part of the solid line, A. This sudden rise is the primary cause of investment fracture during burnout. The temperature must be raised slowly and carefully to prevent cracking. Observe the more gradual increase in thermal expansion represented in the curves of the admixtures, B and C. This tempered expansion reduces the fracture hazard and permits more rapid application of heat during burnout.

It is interesting to analyze the comparative curves of Cristobalite and the investment admixtures, and to inquire why the thermal expansion curves of the admixtures are more uniform, especially within the temperature range in which the curve of Cristobalite, used alone, rises most precipitously. This is because the combination of materials recommended as a control powder exhibits practically no thermal expansion within the range of temperature within which Cristobalite expands most rapidly. The admixtures do have a fair degree of thermal expansion, however, within the temperature range in which the curve of Cristobalite tends to flatten out. This is especially manifest in the relatively straight line in admixture curve C.

tern from 60° F. to the prevailing room temperature. The resulting reduced investment expansion will then always correctly balance the combined gold shrinkage and the wax shrinkage variable for any prevailing room temperature (Fig. 4). The investment expansion regulating material is called "control powder" in order to distinguish it easily from the original basic investment (Cristobalite).

One starts with a certain amount of straight Cristobalite, about 40 Gm., for investing a pattern at a room temperature of 60° F., and gains the desired casting fit when casting into the mold at red heat. At 70° F. a certain amount of expansion control powder is substituted for a fraction of the Cristobalite in order to reduce the expansion of the investment admixture an amount equivalent to the expansion of the wax pattern from 60° to 70° F. Again one casts into the mold at red heat. At an 80° F. investing room temperature, twice as much control powder is substituted for Cristobalite as is used at 70° to compensate for the 20° expansion in the wax pattern from 60° to 80° F. In the same way, at 90°, three times as much control powder is substituted, and at 100° F., four times as much. Thus the expansion of the investment admixture is always regulated so that it correctly compensates for both the shrinkage of gold and for the wax shrinkage variable, at any given investing room temperature, without ever varying the mold temperature when casting.

The control powder is not added to the original 40 Gm. of Cristobalite because that would increase the amount of the admixture. The total amount of investment admixture remains the same, the amount of Cris-

It should be remembered that the effective setting expansion must always be added to the thermal expansion of any investment when the total compensatory investment expansion is figured; also, it should be kept in mind that casting should in all instances be uniformly performed at red heat, about 1300° F.

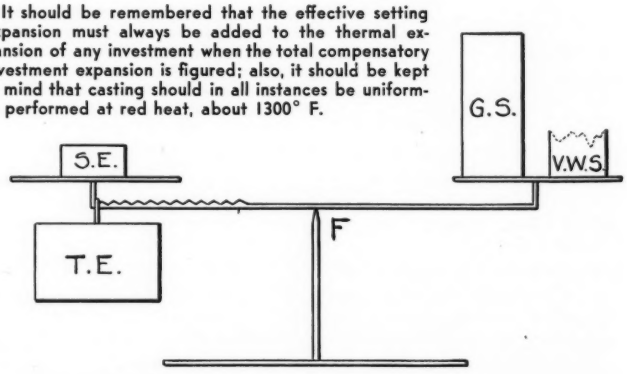


Fig. 5—Shrinkages (G. S. = gold shrinkage; V. W. S. = variable wax shrinkage) correctly balanced by expansions (S. E. = setting expansion; T. E. = thermal expansion). Note that the thermal expansion (T. E.) is represented as a movable counterbalance weight that can be moved toward the fulcrum (F.) to regulate and reduce the thermal expansion to accommodate for any decrease in the variable wax shrinkage and thus maintain balance.

tobalite being reduced as the amount of control powder is increased; that is, the control powder is merely substituted for the Cristobalite.

This expansion control method introduces the necessary adjustable link into the chain of inlay technique before spatulation of the investment is even begun, so that one may proceed with the entire investing and casting processes without variation at all times, always burning out to the same degree of mold temperature. Thus, investing and casting are completely standardized, from the time the investment is introduced into the water for spatulation to the finished casting. The expansion control method fulfills the formula illustrated in Fig. 5.

In order to carry out this standardized procedure, however, and to effect constant precision in this manner, one is entirely dependent on an original basic investment material with a high coefficient of expansion, such as Cristobalite.

age practical inlay work in which the direct method of taking the wax pattern is employed. If the indirect method is employed, a somewhat smaller investment expansion can easily be effected, if desired, by decreasing the proportion of Cristobalite sufficiently to offset the expansion of materials on which the patterns are adapted, or to effect any other variations that a particular indirect method technique requires. A simple way to accomplish this will be described later.

Measure by weight instead of by volume is preferred because errors as large as 15 per cent occur in volumetric proportionment of powder materials performed by different operators. It would be a nuisance and a rather arduous task to weigh out the exact amount of Cristobalite and control powder required each time for investing at the particular room temperature prevailing, if a standard metric scale were used. Besides, it would require expensive weighing equipment. To speed and simplify the proportion-

PROPORTIONS OF CRISTOBALITE AND AN EXPERIMENTAL CONTROL POWDER FOR INVESTING AT VARIOUS ROOM TEMPERATURES (GIVEN BY WEIGHT)

Room Temperature	*Cristobalite*	*Control Powder*	*Resulting Admixture*	*Water*
60° F.	40 Gm.	0 Gm.	40 Gm.	16 Cc.
65° F.	36 Gm.	5 Gm.	41 Gm.	16 Cc.
70° F.	32 Gm.	10 Gm.	42 Gm.	16 Cc.
75° F.	28 Gm.	15 Gm.	43 Gm.	16 Cc.
80° F.	24 Gm.	20 Gm.	44 Gm.	16 Cc.
85° F.	20 Gm.	25 Gm.	45 Gm.	16 Cc.
90° F.	16 Gm.	30 Gm.	46 Gm.	16 Cc.
95° F.	12 Gm.	35 Gm.	47 Gm.	16 Cc.
100° F.	8 Gm.	40 Gm.	48 Gm.	16 Cc.
105° F.	4 Gm.	45 Gm.	49 Gm.	16 Cc.
110° F.	0 Gm.	50 Gm.	50 Gm.	16 Cc.

It will be noted that the weights of the admixtures, given in the accompanying table, increase as the investing room temperature rises and more control powder is substituted for Cristobalite. This is because the control powder is composed of heavier, denser materials. As the thermal expansion of the investment admixture is reduced one can at the same time improve certain physical properties of the investment. Full advantage is taken of this opportunity to better the physical properties by the employment of a control powder material of higher specific gravity and with greater strength and density.

The improvement in the physical properties of the resulting admixture over those of straight Cristobalite will be taken up a little later in this article. The recommended temperature-proportions are for use in avering procedure, a simple scale (Fig. 6) has been devised, with 5 degree room-temperature graduations, which automatically weighs out just the correct proportions of Cristobalite and control powder necessary for investing at the corresponding room temperature. At the same time, it affords the proper total amount of investment admixture for one investing operation. It also provides for weighing out the exact amount necessary.

THE AUTOMATIC SCALE

There are only three parts to the scale, the platform, the cross arm, and one cup. There are no counterweights used; the body of the scale itself provides the necessary counterbalance as the position of the fulcrum is changed. Simple as it is, however, this scale eliminates "variables" from any further consideration. The slight deviation from the ordinary method of weighing investments, incident to its use, dwindles into insignificance when it is realized that with every pattern an identical investing and casting procedure can be followed with utter disregard of the "variable" bugaboo.

The automatic scale is employed in the following manner:

1. Water of room temperature is weighed out in the cup placed on the left side (Cristobalite side), the scale being balanced at the point marked "Water" (90 degree graduation). The water is placed in the mixing bowl, the cup dried, and again placed on the left side, marked "Cristobalite."

2. The room temperature is noted and the fulcrum is adjusted to the corresponding temperature graduation on the same side of the scale. Sufficient Cristobalite is placed in the cup to effect balance and then placed in the mixing bowl and allowed to take up the water.

3. Next, the cup is placed on the right side (control powder side), and the control powder weighed out in the same way, the same room-temperature graduation being employed on that side of the scale. The control powder is then placed in the mixing bowl with the Cristobalite and water, and the standardized investing and casting procedures are followed at all times.

Thus, in a few moments, the exact expansion necessary is "built" into the investment admixture and the flexible link is introduced into the chain of inlay procedure in the simplest possible manner. Balancing the

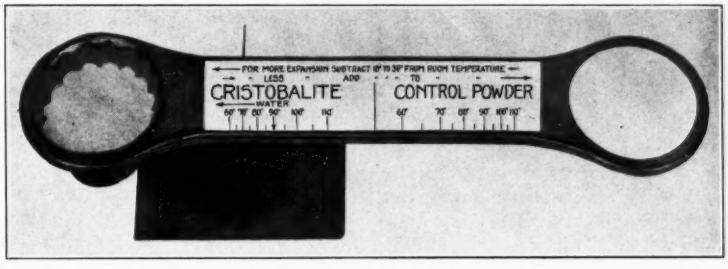


Fig. 6—The automatic scale.

cup on the prevailing room-temperature graduations of the scale is all the technique required.

The automatic scale provides an investment admixture with a thermal expansion slightly less than is employed for investing patterns for M. O. D. metal dies and slightly less than would effect full theoretical balance of shrinkages. The thermal expansion is regulated, throughout the entire investing temperature range, to the exact extent found ideal for average practical inlay work.

In seeking a material to be used in this method for controlling the thermal expansion of Cristobalite, it was obviously necessary to avoid the use of any material that altered the setting time, or impaired any of the favorable characteristics of the basic material, Cristobalite. It was soon evident that some of the very materials useful in reducing expansion could be employed practically to nullify the disadvantageous characteristics of Cristobalite used alone. It was definitely established that when the proportion of control powder was increased, as the room temperature rose, certain desirable physical properties became decidedly pronounced: (1) crushing strength increased; (2) the tendency toward fracture and flaking was far less evident; (3) the caution and time required for burnout were so reduced that, when the control powder was added properly to balance the expansion of the investment admixture for investing a pattern at 85° F. or higher, rapid elimination (burnout being started in a hot oven) was possible with no harmful result.

Pure binder materials, such as plaster, were tried; it was found that marked reductions in the thermal expansion of the investment could be effected with relatively small quantities. But plaster requires more water, both by weight and by volume, and its use thickens the mix unduly when a fixed amount of water is used, as in this method. The use of plaster would necessitate varying the amount of water used with various admixtures for investing at different temperatures, and this alone would render its use undesirable. Besides, it seems more practical to use a material requiring somewhat greater bulk so as to reduce the liability to error; then, a little variation or error in the proportions of the materials used would make a scarcely perceptible difference, whereas the same variation in the amount of plaster employed would increase the error in proportion to its greater effectiveness.

In the early research work along these lines the experiments were carried out with materials commercially available. Many of the lower-expansion inlay investments were tried. Some possessed characteristics that rendered them undesirable for use as a control powder. Of the materials available, Coe Inlay Investment worked out more satisfactorily than the others and was especially adapted to experimental work because of its slow setting time. This permitted the use of a water immersion bath to check the experimental casting findings with the theoretical compensatory investment expansion figures at high pattern investing temperatures. Fortunately, the proportion of this control material increased and the setting time of the resulting investment admixture became longer as the investing temperature rose. While this was an advantage in experimental work, it must be admitted that it was not so desirable in practical work where the setting time was needlessly prolonged. This particular disadvantage was overcome in part by the substitution of Coe Universal Investment, although this material, also, prolonged the setting time somewhat when mixed with Cristobalite. Coe Inlay Investment was the regulating material used in the accompanying graphs, except where otherwise noted.

It has been my good fortune to have worked with superexpanding investments since 1931. Periodically, experimental samples of such materials have been received from the research department of the Ransom & Randolph Company. Some of these investments have demonstrated remarkable thermal-expansive properties. In fact, experimental results with some of these materials have demonstrated that investment expansion, even in excess of the requirements, can be obtained.

Fig. 7 represents the improvement in crushing strength which results from the introduction of control powder with Cristobalite. The improvement is in proportion to the amount of control powder used.

These tests, made on cold, unburned samples, are interesting; but, in my opinion, they are not so consequential as similar tests made with samples crushed at the mold casting temperature. The crushing strength of an investment material in this hot, burned condition, in which such a physical property is of most practical significance, is the real meat of all such data. Repeated tests with samples crushed "hot" revealed astounding improvement of crushing strength in the control powder admixture; in fact, the improvement was far greater proportionately than in the "cold" tests.

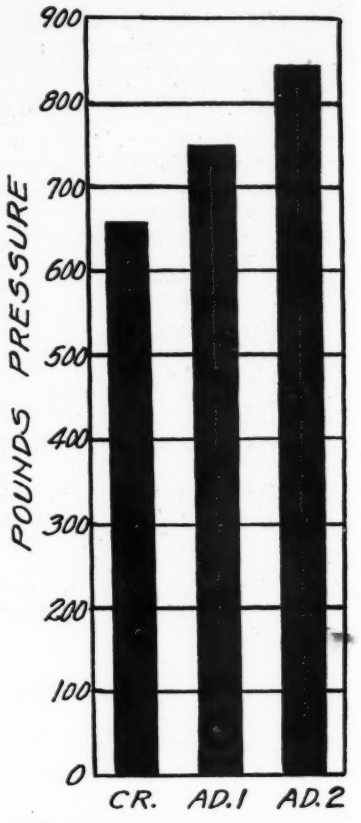


Fig. 7—CR., Cristobalite used alone; AD. 1, admixture of 75 per cent Cristobalite and 25 per cent control powder; AD. 2, admixture of 50 per cent Cristobalite and 50 per cent control powder. This demonstrates the improvement in crushing strength in the investment admixtures effected by increased proportions of control powder. The samples were crushed fifty-five minutes after spatulation. The findings were recorded on a Southwark-Emery machine.

Requirements of a Control Powder

1. A control powder must have a materially lower maximum thermal expansion than Cristobalite, but should not exceed 0.8 per cent.

2. A control powder should have a thermal expansion curve representing comparatively low expansion in the temperature range from 380° to 500° F. in order to temper the abrupt expansion of Cristobalite within that temperature range and to counteract the tendency to fracture when heat is applied.

3. A control powder must possess greater crushing strength than Cristobalite.

4. It must have a similar setting time.

5. A control powder must be chemically compatible with Cristobalite so

that none of the desirable physical properties of the latter will be impaired.

6. A control powder should have, in addition, all the necessary fundamental physical properties of inlay investments, such as resistance to heat, for example, and a certain degree of porosity.

An Experimental Control Powder

Recently, considerable research work has been conducted with the object of developing an experimental control powder that would fulfill every one of the requirements mentioned. Many experiments with different materials dictated that a higher percentage of binder materials be employed in the control powder than are now ordinarily used in the high-expansion inlay investments. This was desirable mainly because it materially increased the crushing strength. The thermal expansion curves of investments with a high quartz content reveal practically no thermal expansion between 380° and 500° F. This property made quartz particularly desirable as the primary refractory in the control powder because it modulated the abrupt thermal expansion of Cristobalite within that range of temperatures and thus prevented investment fracture during burnout.

Ideal results have been obtained with this material not only in experimental tests but in practical work as well. If the ingredients in this experimental control powder are correctly balanced the same consistency of mix at all times can be maintained without varying the fixed quantity of water used, regardless of the different proportions of the two materials used in the investment admixture for investing at various room temperatures. This experimental control powder was the material used in Fig. 8 representing the greatly decreased burnout time required when the investment admixture with a control powder was employed.

An investment made of Cristobalite alone requires burnout with extreme care if fracture is to be avoided. The manufacturer recommends low heat (from 200° to 300° F.), from twenty to thirty minutes; then medium heat (from 450° to 500° F.), from fifteen to twenty minutes; then high heat, so called (from 600° to 800° F.), until the investment loses its brown color. Thus, much technique and "watchful waiting" are introduced into the burnout procedure. With the control powder method, burnout, for average as well as for higher than average room-temperature pattern investing, can be performed much more quickly and with greater safety, because the thermal expansion curve of the resulting admixtures, especially in the dangerous temperature range between 380° and 500° F., is more gradual. True, the thermal expansion of this admixture at 800° F. is not so great as that of Cristobalite at that temperature, but the exact thermal expansion desired is always obtained by casting into the customary red-hot mold, where it is easy to determine relative temperatures by the color of the mold.

Variations in Expansion for Different Types of Castings

The possibilities of easily varying the investment admixture expansion for castings to be used in different types of tooth preparations, and for the indirect method, have been referred to previously in this article. For example, it is found advisable to employ slightly less thermal expansion for three-quarter crown castings for anterior teeth than for average inlay work. Also, some operators prefer a little tighter fit for slice preparations. These variations can easily be produced to any desired degree without making any change in the standardized investing and casting procedures. To reduce expansion in anterior three-quarter crowns for actual mouth work, from 10 to 30 degrees are added (20 degrees are usually correct) to the prevailing room temperature, when adjusting the automatic scale, and the standardized procedure is followed. If the temperature of the room is 75° F., the materials are weighed out on the 95° F. graduations on the scale. This automatically reduces the thermal expansion of the admixture by increasing the proportion of control powder used. Likewise, backings adapted, for example, to tube teeth, at any given room temperature can be made to fit a little more snugly

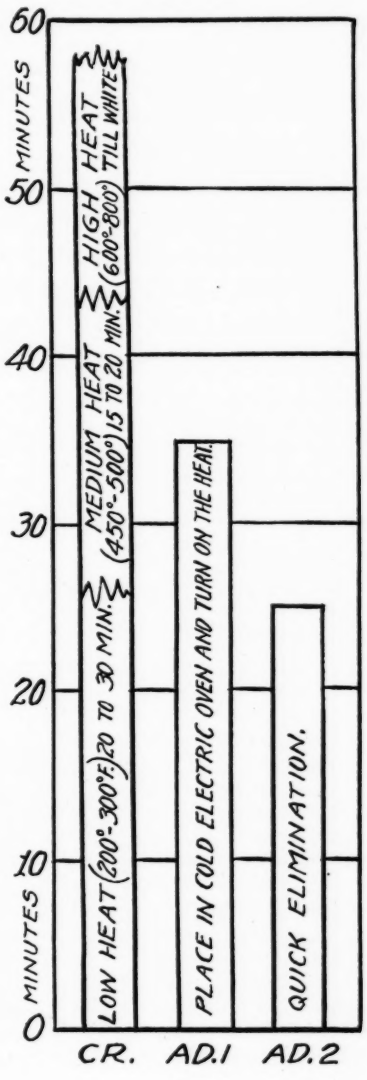


Fig. 8—Graphic representation of the reduction of time, watchfulness, and hazard, during burnout resulting from the use of an admixture of Cristobalite and the experimental control powder.

Column CR. represents the correct burnout for Cristobalite used alone, as recommended by the manufacturer to be employed at any investing room temperature. Practically an hour is required in an electric oven with delicate heat control.

Column AD.1 illustrates the shorter burnout time required when the control powder admixture is employed for investing the pattern at a room temperature of 75° F. Not only does this obviate the necessity of regularly readjusting the temperature controls of the furnace, but it also considerably shortens the total time required for burnout. The mold may be placed in practically any ordinary high-heat electric furnace without definite means of temperature control, and, starting with a cold oven, the heat turned on. The control powder tempers the sudden thermal expansion of Cristobalite (illustrated in the thermal expansion graph Fig. 4) to such an extent that the temperature rise in the average electric furnace is sufficiently gradual, when burnout is started in a cold oven, to defeat the danger of fracture.

Gas can be easily employed. The flame is turned on half way for twenty minutes; then the full flame is applied until the sprue hole shows a bright red color.

Column AD.2 represents the "quick elimination" burnout, in an oven heated beforehand, permitted by a control powder admixture when investing is carried out at summer temperature, 80° F. or higher.

It should be noted that, as the investing temperature rises and the proportions of the control powder are increased there is a decided improvement in the safety factor as well as a marked decrease in the time required.

by adding from 10 to 30 degrees to the existing room temperature when the scale is employed. If more than average expansion is desired as, for example, in a full crown casting, from 10 to 30 degrees are subtracted from the prevailing room temperature, and the automatic scale is employed with the temperature graduations thus lowered. In this way the operator can control expansion of the investment as he desires for any type of casting without deviating in any way from the standardized technique.

To simplify this procedure, to prevent error, and to obviate the necessity of figuring out each time how to employ the automatic scale for the purposes just mentioned, arrows are on the scale to indicate the direction in which the scale is shifted to obtain either greater or less expansion.

All the flexibility heretofore made possible by the water immersion bath can be "built" right into the investment regardless of the investing room temperature, and the same investing and casting procedures may always be followed. The outstanding advantages of the water immersion bath technique were that (a) it provided the only means for always obtaining the same degree of *casting precision,* or any desired flexibility of fit, *under varying investing conditions* while (b) it permitted the operator always to cast *at the same mold temperature,* red heat.

The automatic expansion control method, when used in combination with Cristobalite, retains both these most important advantages of the water immersion bath technique and at the same time utilizes the most favorable characteristic of Cristobalite; namely, sufficient expansion for pattern investment at any prevailing room temperature.

The advantages of both techniques are thus linked in such a way that there is no need delicately to control either the temperature of the pattern when investing, or the temperature of the mold when casting.

Research Method

For determining experimentally the correct proportions of control powder necessary to offset the wax shrinkage variable at different investing room temperatures, and for checking empirical research findings with theoretical expectations, the standard M.O.D. 2 per cent taper dies were used. I consider this form of die of most practical value for these purposes, and believe that the comparative expansion recordings have a direct bearing on practical work from this standpoint, despite the fact that slightly greater expansion was uniformly employed at all investing temperatures for the die castings. The necessary adjustment was made by using the automatic scale graduations from 10 to 15 degrees below the recorded room temperature. This provided a uniformly decreased amount of control powder for experimental work with these dies at all investing temperatures.

Countless castings of this nature, and a great number of practical castings, have served to verify the simple practicability of the theory underlying this expansion control method. Castings for these dies have been perfectly fitted over a range of investing temperatures from 70° to 114° F. For experimental purposes, temperatures of 100° F. and higher were maintained by a thermostatically controlled water bath, a well retarded investment admixture having been used.

It has been the practice at the Bureau of Standards to evaluate inlay techniques by their ability to effect sufficient compensatory expansion to fit metal M. O. D. dies. A fit of this nature is desirable even for practical work when casting a molar occlusal inlay. It is a perfectly fair requirement, but it is also essential that one have full control of casting dimensions in addition. Both of these exacting requisites are fully met in a manner already described. For average practical inlay work I prefer to employ the amount of expansion represented by a somewhat tight fit on the metal die. In my opinion, this probably affords better and safer results in the hands of most dentists.

All tests of casting results were uniformly made with the same water-plaster ratio and identical mechanical spatulation; and all patterns were invested in absolutely the same manner by the automatic investing machine, which duplicates every investing movement to the second and insures investing without the introduction of bubbles which might destroy the value of the experiments.

It is indeed fortunate that the thermal expansion curve of a good inlay wax, unlike the expansion curve of investments, is a relatively straight line in the probable investing temperature range. In fact, the thermal expansion is sufficiently uniform per degree throughout this range to render unjustified the introduction of any complications to satisfy theoretical squeamishness.

The average cooling curve of a good inlay wax, however, under conditions in which this material is employed in inlay work, should be determined, now that the primary concern is with wax shrinkage, not wax expansion. In physics, the delineation of the cooling curve of a material is not always identical to that of its thermal expansion curve. This is strikingly illustrated in the divergence of these two curves of any inlay investment material.

In developing this procedure one thought has been uppermost in mind: to make it as practical as possible and to attain genuine precision in the easiest and simplest way. In actual practice it has been found that this simple, standardized precision technique permits delegation to assistants of the entire investing and casting procedure. The operator merely hands a sprued pattern to the assistant who later delivers a clean pickled casting.

The process is rendered less complicated by the use of a machine for investing. Also, time is saved, for the machine has the capacity to invest as many as four patterns at one time in a single ring. In my experience, an automatic investing machine is more essential in inlay procedure than a casting machine, because it supplants handwork with mechanical means for a more difficult operation. The assistant's results are just as good as those of the operator himself.

Basic Investment Requirements

There is considerable doubt, not only in the minds of the profession, but also among the dental manufacturers, regarding the exact amount of expansion that should be built into an investment; there has been the bugaboo of overexpansion in the super-expanding investments. On the other hand, those skilled in the casting art recognize that an investment which can be safely employed for investing at summer temperatures requires a most kindly tolerance of large shrinkages by the operator when investing is carried out in the range of ordinary room temperatures. Any investment, therefore, which has the right compensatory expansion for investing in one room-temperature range is incorrect for investment in any other temperature range, unless a change in technique is introduced. Furthermore, even to achieve fastidious accuracy in different types of castings, which require varying degrees of expansion or shrinkage, requires some simple method of investment expansion flexibility. To defeat the variables in inlay procedure any one investment used without some exact and simple means of expansion regulation would be inadequate.

It seems to me that all that is required from the manufacturer is an

investment with sufficient expansive properties to fulfill the maximum requirements, such as Cristobalite. Then it is merely a matter of reducing the inherent thermal expansion in the investment to the extent necessary to compensate correctly for the wax temperature-dimensional variable with the simple control method described. The combination of this material and the method described here answers the much debated questions: How much expansion shall we build into an investment? How shall we control this investment expansion?

Advantages of Cristobalite

Cristobalite (1) has the ideal maximum expanding qualities required; (2) it compensates for shrinkages mainly by its thermal expansion; (3) lends itself perfectly to expansion control for precise casting with the method herein described; (4) obviates the necessity of the double mix and the putty-like mix; (5) produces beautiful, smooth castings, and (6) dispenses with artificial wax expansion.

Why Precision Casting?

To the man who says, "I get pretty fair results without precision casting," which usually means that some haphazard technique is employed, the following reasons should prove sufficient stimulus to create a desire for better workmanship in this important field:

Precision casting (1) requires not even a minute's time; (2) it is a great time saver at the chair, especially when fitting the casting; (3) the number of "remakes" is reduced; (4) the patients' teeth are better protected, and their health is more honestly safeguarded, and (5) superior workmanship leads to larger financial returns.

Summary of Advantages in the Use of Automatic Expansion Control

The automatic expansion control:

1. Eliminates the danger of overexpansion.
2. Is precise; regulates the inherent compensatory expansion of the investment to the exact degree necessary for precision.
3. Possesses expansion flexibility; permits the fastidious technician to produce any variation in expansion he desires for different types of castings.
4. Is extremely simple; as uncomplicated as Taggart's original procedure:
   - A. A simple thick creamy mix is used at any prevailing room temperature;
   - B. No further particular attention is required except to start burnout in from 25 to 30 minutes, and to cast at red heat.
5. Is quick:
   - A. Requires only a fraction of a minute more of the operator's time than the quickest and most haphazard method;
   - B. Permits employment of an investment with an initial set of 10 to 13 minutes.
6. Is consistent; precise results can always be duplicated.
7. Is completely standardized; irrespective of any variables the same procedure is always followed from beginning to end.
8. Minimizes wax distortion; the pattern is neither chilled nor reheated.
9. Is reasonably "safe."
   - A. Errors due to failure to carry out any special steps at a particular time while the investment is setting are eliminated because no attention whatever is required from the point of pattern investment to the final investment set.
   - B. Errors in burnout are minimized:
     - (a) Practically eliminates the liability to fracture of Cristobalite during burnout.
     - (b) Avoids flaking.
10. Permits casting at all times within a temperature range in which the color of the mold is a reliable gauge of mold temperatures.
11. Materially shortens burnout time of Cristobalite.
12. Obviates the necessity of pyrometer furnaces.
13. Avoids the scrapping of burnout equipment now in use.
14. Permits the use of the gas oven for burnout.
15. Is completely automatic; the room-temperature graduations on the scale automatically determine the proportion of the materials in weighing.
16. Requires no expensive weighing equipment.
17. Overcomes variables by a change in materials, *not by changes in technique*.
18. Increases the crushing strength of Cristobalite.
19. Utilizes all the advantages of superexpanding investments and eliminates practically any danger in their use.
20. Eliminates guess work.
21. Requires no elaborate equipment; only an inexpensive mechanical spatulator and weighing means are to be considered essential; because they simplify the procedure, an investing machine, a casting machine, and an electrical burnout oven are desirable in the order named; perfect distribution of the mix over all delicate pattern irregularities, by hand, is more difficult than "hand" casting with a moist asbestos pad. An automatic investing machine practically eliminates all "technique" from the procedure.
22. Effects improvements in the physical properties of Cristobalite whether investing is performed at average room temperature or at higher room temperatures.
23. Produces smooth castings; a thick creamy mix is employed.
24. Makes exacting standards of excellence fully compatible with simplicity; useful to the expert technician and novice alike.

Conclusion

Cristobalite possesses the ideal maximum thermal-expansion properties necessary in an inlay investment, and lends itself perfectly to the described method of expansion regulation for precise work.

The automatic expansion control method is so exact and so simple that it places precision casting into the hands of every dentist.

Author's Note: A sample of improved Cristobalite was received from the manufacturer after this article was set up. Tests indicate that it can be safely burned out with reasonable rapidity. This is particularly helpful when the method of expansion control described in this article is used, because the recommended burnout can be employed even in the lowest investing temperature range. The thermal expansion of the new material remains practically the same.—D.W.P.

ABOUT OUR CONTRIBUTORS

Max J. Exner, B.S., M.D., took his premedical work at Carleton College, Northfield, Minnesota, and in 1906 graduated from the University Medical College, Kansas City, Missouri. Doctor Exner is Associate Fellow of the American Medical Association. He has had considerable research experience in the field of social hygiene. Doctor Exner's address is 110 Morningside Drive, New York, N. Y.

The biography of David W. Phillips, D.D.S., appeared in the April, 1932, issue.

George Schneider has his D.D.S. (1900) from the Chicago College of Dental Surgery. Doctor Schneider is the author of several articles on bone restoration after the surgical removal of teeth. He belongs to the A.D.A., Illinois State Dental Society, La Salle Component Society, and the Eighth International Dental Congress, and practices dentistry at 126 Marquette Street, La Salle, Illinois.

Leonidas Smith took his D.D.S. in 1905 at the Indiana University School of Dentistry. Doctor Smith has written several professional magazine articles. He is a member of the A. D. A., Indianapolis Dental Society, Indiana State Dental Society, and Psi Omega. Doctor Smith has a general practice at 809 Chamber of Commerce Building, Indianapolis.

DENTAL ASSISTANTS AND SECRETARIES

ELSIE GREY

Material and Formula for X-Ray Developing Solution

Question—I would appreciate a formula for the making of my own developing solution for x-rays. We are in a small town and must rely on our own resources much of the time.

C. B., Iowa

Answer — Although proprietary ingredients for the x-ray solution are easily obtained on the market, in case of necessity the following is given: With a bur or stone etch a line on a large glass bottle or jug demarcating the position of 100 ounces. This position can first be established by tracing with wax the line marking a 100 ounces of water. One 24 ounce graduate glass and one small scale is also needed.

Formula:

Caustic potash	½ pound
Sodium sulphite (dry)	½ pound
Potassium bromide	1¾ ounces
Distilled water	
Hydrochinone	

1. Twenty-five ounces of distilled water is put into a jug to which the half pound of caustic potash is added and allowed to dissolve. In a porcelain dish or pan the half pound of sodium sulphite is dissolved in 30 ounces of hot distilled water, and in a cup the potassium bromide is dissolved in a little hot distilled water. When these ingredients are thoroughly dissolved, they are poured into the jug and sufficient distilled water added to reach the 100 ounce line.

2. The hydrochinone is weighed in units of 2 drams and placed in small vials ready for use. When the developer is to be used it is poured out of the stock jug into the glass graduate, 8, 16, or 24 ounces of the content. For every 8 ounces of stock 2 drams of hydrochinone is added and allowed to dissolve thoroughly.

3. The contents of the graduate glass should be strained through fine cheese cloth into the developing tray before using.

4. The stock solution should be kept in a dark, cool closet after it has been sealed with paraffin or wax. A bottle or jug of dark glass will help preserve the contents. After the solution has been used it should be poured from the tray into a dark glass bottle and kept tightly corked in a dark cool place as the stock solution is kept.

5. When the solution is fresh films will develop in about fifty seconds, but it will take a little longer when the solution has been used. One can determine when to discard the developer by the appearance of the films and the discoloration of the solution. The solution should not be used too long if clear sharp outlines and details are to be obtained on the films.

6. The chemicals used can be purchased in any drug store, except the hydrochinone which must be obtained from a dealer in photographic supplies.

7. One should be sure that all the containers and utensils used are clean, and the solution should always be strained before it is used.

Filing Records

Question—Will you please give me some simple rules for filing charts, records, etc. Doctor has never had a secretary and I want to put his correspondence, records, and charts in order. We have a new filing cabinet with three large drawers which hold letter size folders and index cards, and four small drawers which hold 4 by 6 index cards which I will use for our working charts and x-rays in current use.

—X. Y. Z.

Answer—All entries of names, addresses, telephone numbers, references, etc. should be typed for legibility and to facilitate reference and classification. The surname should always come first, followed by a comma and the Christian name or names, and then the title in parentheses: (Mrs.), (Prof.), (Dr.).

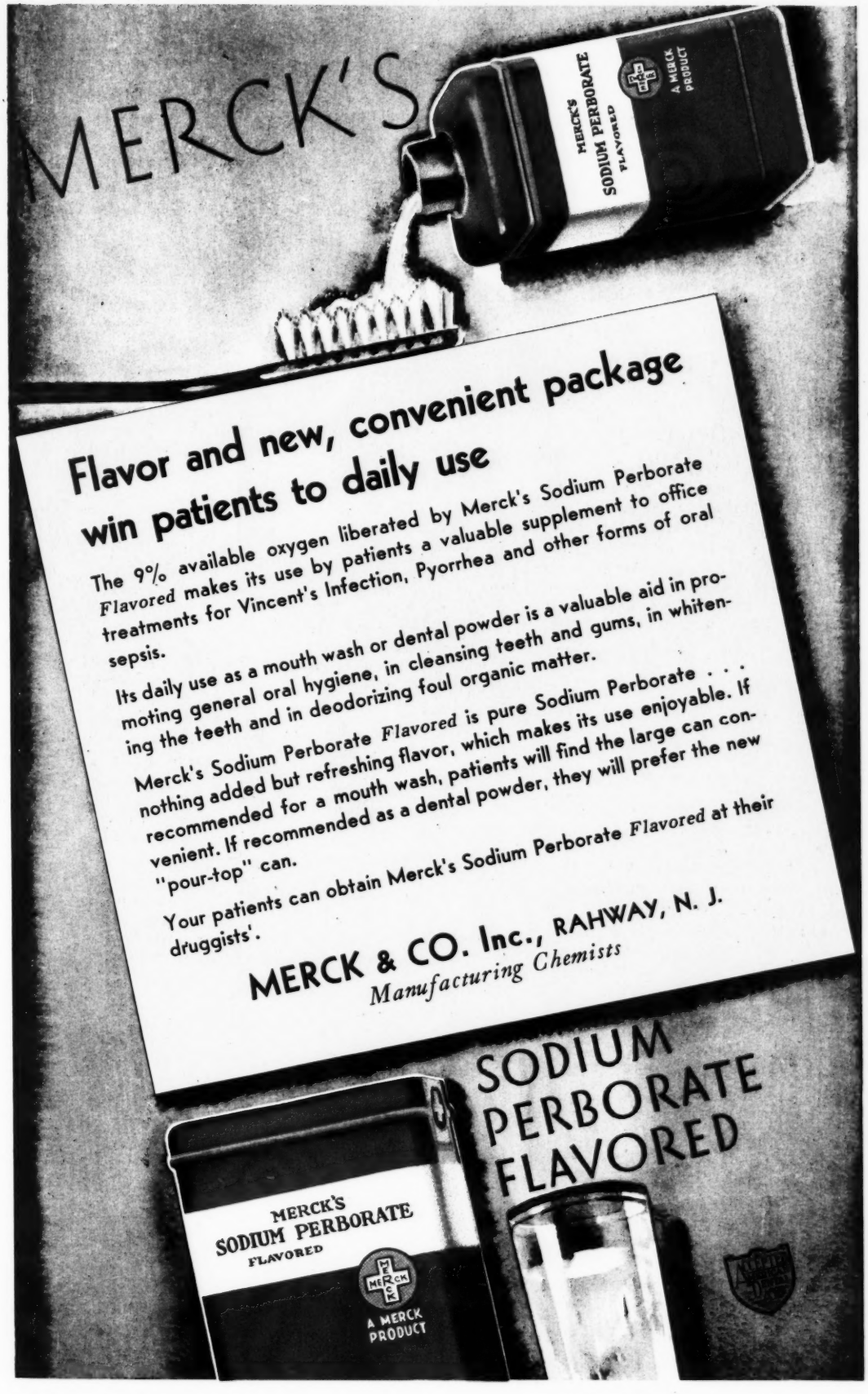
Names should be filed according to their spelling, even when they are pronounced alike. The only cross reference required is in the case of a difference in the spelling of a last name; for example: Monroe, James K., See also Munroe; and Munroe, Edward F., See also Monroe.

When filing several records for one surname, file according to the alphabetical order of the Christian names. Hyphenated surnames are filed according to the first part of the hyphenated name. Names that begin with a prefix, such as "de," "la," or "von" are filed with the prefix as a part of the name; also names beginning with "D' " or "L' " are filed without regard to the apostrophe; however, if the "La," "Le," or "El" are used instead of the word "The," such as "El Hacienda Co.," the prefix is disregarded and the record is filed under the name of the company. Names beginning with numbers are indexed as though the number were spelled out, such as in "2nd National Trust Co." Titles with descriptive words should be indexed so that the main entry will come first, such as "Trustees of the American Dental Association" which should be filed, "American Dental Association, Trustees of."

Dental records are important and should be as complete as possible. Physical idiosyncrasies of the patient should be noted; shades and molds of artificial teeth used; all data related to a completed case should be placed in a folder with the x-rays and filed together. If the study models are to be preserved they should be numbered and the number should be recorded on the chart with the date when the models were made. Models can be filed away according to serial number in boxes on which is indicated the serial numbers of the contents. An ideal way is to have a closet with shallow shelves on which the models can be kept in serial order.

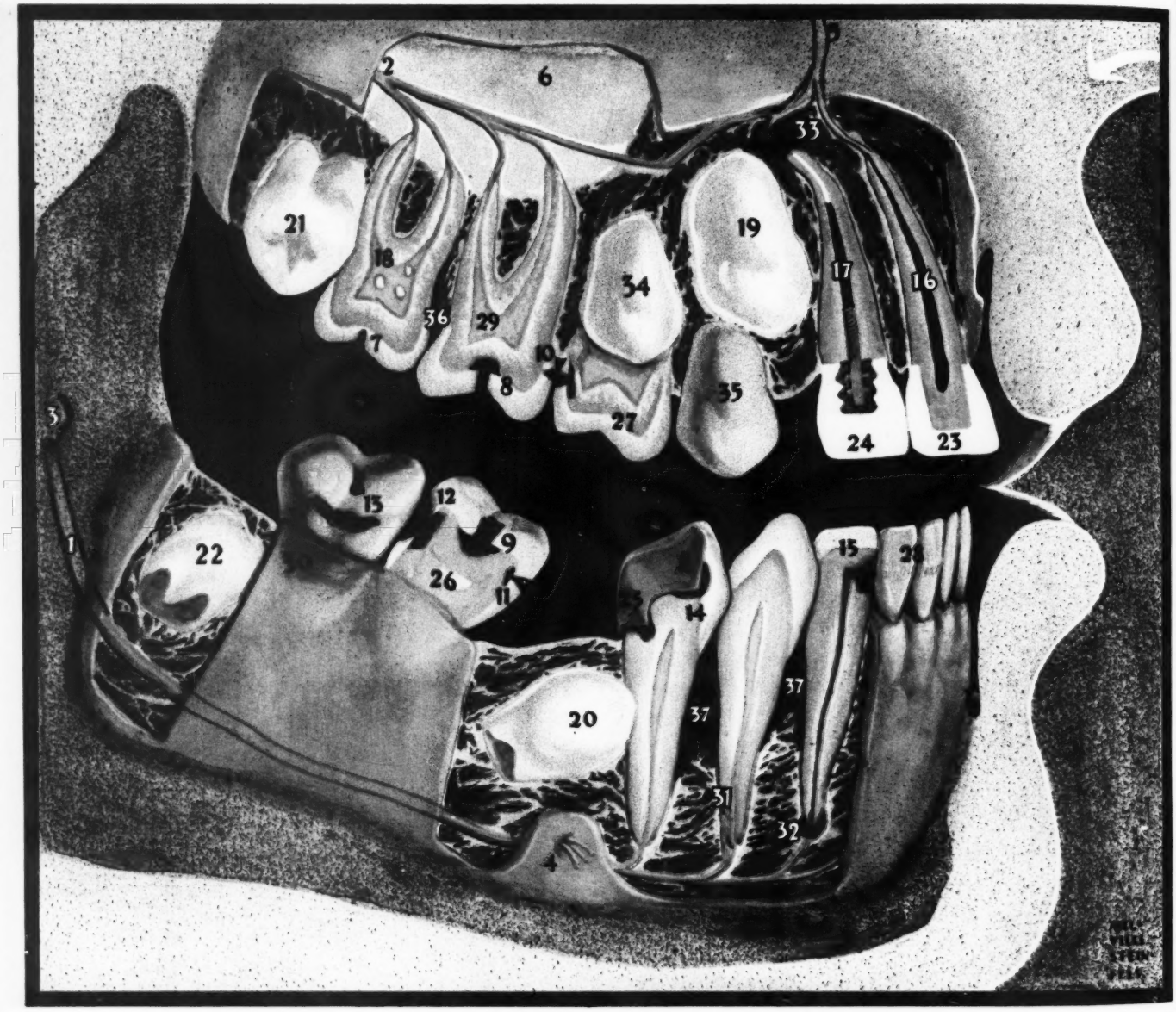
In the small file drawers, several sets of index cards may be kept: one set for current charts and one for current x-rays in envelopes properly indexed; one for finished charts for which bills have been sent; one set for indexed cards for recalls; one for finished, paid accounts, the charts for which you have not had time to file in their folders, and one for the x-rays in these cases.

One of the large drawers should be kept for your employer's personal correspondence, and for filing of such notices, cards, lists, and programs as he may wish to keep separate from those pertaining to dental societies.


MERCK'S
MERCK'S SODIUM PERBORATE FLAVORED
A MERCK PRODUCT
Flavor and new, convenient package win patients to daily use
The 9% available oxygen liberated by Merck's Sodium Perborate Flavored makes its use by patients a valuable supplement to office treatments for Vincent's Infection, Pyorrhea and other forms of oral sepsis.
Its daily use as a mouth wash or dental powder is a valuable aid in promoting general oral hygiene, in cleansing teeth and gums, in whitening the teeth and in deodorizing foul organic matter.
Merck's Sodium Perborate Flavored is pure Sodium Perborate . . . nothing added but refreshing flavor, which makes its use enjoyable. If recommended for a mouth wash, patients will find the large can convenient. If recommended as a dental powder, they will prefer the new "pour-top" can.
Your patients can obtain Merck's Sodium Perborate Flavored at their druggists'.
MERCK & CO. Inc., RAHWAY, N. J.
Manufacturing Chemists
SODIUM PERBORATE FLAVORED
MERCK'S SODIUM PERBORATE FLAVORED
A MERCK PRODUCT

THE EDUCATION OF THE DENTAL PATIENT*

I. DENTAL CONDITIONS



LANDMARKS

1. Mandibular nerve
2. Maxillary nerve
3. Mandibular foramen
4. Mental foramen
5. Infra-orbital foramen
6. Maxillary sinus

CARIES *(Occlusal)*

7. First degree
8. Second degree
9. Third degree

CARIES *(Proximal)*

10. First degree
11. Second degree
12. Third degree
13. Buccal pit and cervical
14. Under the filling
15. Pulp Exposure and pathologic change at apex

ROOT CANAL FILLINGS

16. Proper to end
17. Improper with root-end infection

PULP STONES

18. Calcification nodules

IMPACTIONS

19. Cuspid
20. Lower second bicuspid
21. Upper third molar
22. Lower third molar

MISCELLANEOUS

23. Porcelain jacket
24. Davis crown
25. Overhanging filling
26. Secondary dentine
27. Loose deciduous molar
28. Hypoplasia
29. Pulp tissue
30. Irritated gum tissue
31. Supernumerary root canal
32. Slight degeneration at the apex
33. Marked degeneration at the apex
34. Erupting second bicuspid
35. Incomplete first bicuspid
36. Pyorrhea pocket
37. Pyorrhea pockets

*This is the first of a series of charts intended for the use of the dentist in explaining important normal and pathologic dental conditions to his patients.

—Samuel D. Harris, D.D.S., Detroit

ANNOUNCEMENT

Realizing the growing interest among the dental profession in matters pertaining to a more intimate understanding of prosthetic materials,—we have decided to devote this space to a regular monthly discussion of timely problems.

This discussion will be conducted by Mr. Richard L. Coleman, director of our Department of Metallurgy. The first of his articles will appear in the March issue of this publication.

We invite your attention and also your critical suggestions. It is our desire to present subjects of interest in a manner which will be of real value to you.

THE J. M. NEY COMPANY

CHICAGO HARTFORD NEW YORK

A NEW IMPROVED Platinized Gold BACKING

Steele's NEW PG BACKINGS NOW AVAILABLE IN DEALER STOCKS

A Fusing Point of 2200°F., 350° higher fusing than the old PG Backings . . . The new PG is stronger. It is non-oxidizing and readily responds to heat treatment . . . It is possible to cast directly to this new Backing. Flowing of solder on the back of the backing, fluxing or other preparation prior to casting is unnecessary . . . The above advantages are combined with solid posts, sealed rivets, micrometric accuracy and Steele's usual high quality.

NO ADVANCE IN PRICES

The lines under P and G identify the new improved P G Backings

THE COLUMBUS DENTAL MFG. CO., Columbus, Ohio, U.S.A.

The Important and Incontestable Fact Is That

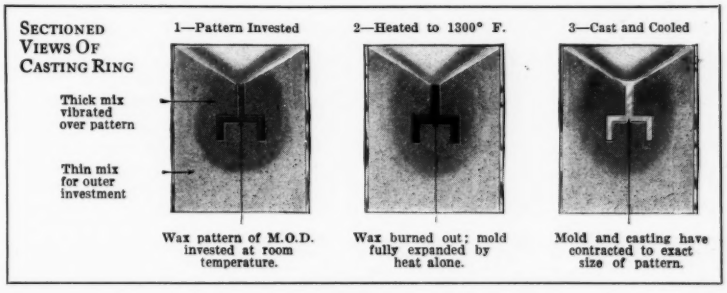
GRAY INVESTMENT
Does *More*...Costs *Less*

Does More: Far from being limited to the casting of inlays and crowns, GRAY serves with equal accuracy for bridges and all types of one-piece castings—in fact, is hard enough to cast full dentures direct to the model. And its great strength makes it suitable for soldering as well. What's more, it serves each purpose *ideally*.

Costs Less: Since neither a more costly investment nor a more prolonged and exacting technic will produce superior results, GRAY INVESTMENT represents true economy not only in its first cost, but in time saved in casting, and in simplification of stock requirements. One investment serves *every need*.

Positive Accuracy in Casting, with the *Simplest* of Technics!

Here's all there is to it →


SECTIONED VIEWS OF CASTING RING
1—Pattern Invested
2—Heated to 1300° F.
3—Cast and Cooled
Thick mix vibrated over pattern
Thin mix for outer investment
Wax pattern of M.O.D. invested at room temperature.
Wax burned out; mold fully expanded by heat alone.
Mold and casting have contracted to exact size of pattern.

And here's what it means . . .

1. *Complete* compensation for shrinkage of gold, without danger of *over*-expansion.
2. Less time required for setting of investment, and much less time for burning out.
3. Burning out and casting temperatures not critical; no temperature recording instruments required. Operator simply casts when sprue-hole glows red.
4. Castings accurate to the thousandth of an inch, with smooth, velvety surfaces practically free from discoloration.

More Investment For *Less* Money

Note *weights* as well as *prices*

Medium can	5 lbs.,	$ 1.35
Large can	15 lbs.,	3.25
Drum	100 lbs.,	15.00

(f.o.b. Toledo, Ohio)

Gray Investment meets the specifications of the American Dental Association for dental casting investments. Table of physical properties appears on each container.

THE RANSOM & RANDOLPH COMPANY
TOLEDO, OHIO

It's Here! . . RESOCAL

An ideal flasking material for LUXENE and other synthetic resin denture materials, as well as for vulcanite. Softens after curing, facilitating removal from flask.

LETTERS

May I take this opportunity to extend my belated congratulations on the excellent magazine you are producing? It certainly fills a great void in the group of dental publications. I have read every issue from cover to cover, including every advertisement—which is more than I usually do with the other publications I receive. I assure you that when the time rolls around again for me to renew my subscription, I shall not take the chance of missing an issue, as I did this time.—D. H. HEIMAN, D.D.S., *Bay City, Texas*

I do not like to miss any copy of THE DENTAL DIGEST because I think it is one of the best dental journals. Your beautiful and instructive illustrations take the place of several pages in describing any technique.—GENERO B. FELIZARDO, D.D.S., *Manila, Philippine Islands*

My first issue of THE DENTAL DIGEST has impressed me very favorably. I think you have the right idea and hope you keep up the good work.—S. K. DOUGHERTY, D.D.S., *San Francisco*

It is with the greatest pleasure that I add my word of congratulation and appreciation to those already expressed at the excellent subject matter and arrangement of THE DENTAL DIGEST. I enjoy your journal more than any other I receive and I subscribe to ten.—L. S. BECKETT, D.D.S., *Sydney, Australia*

Color, art, and giant type make the new DENTAL DIGEST the most beautiful dental magazine ever published. The elaborate cuts and "right-at-the-chair-material" pull interest right out of one.—*The Glendale Dental Society Bulletin, Glendale, California*

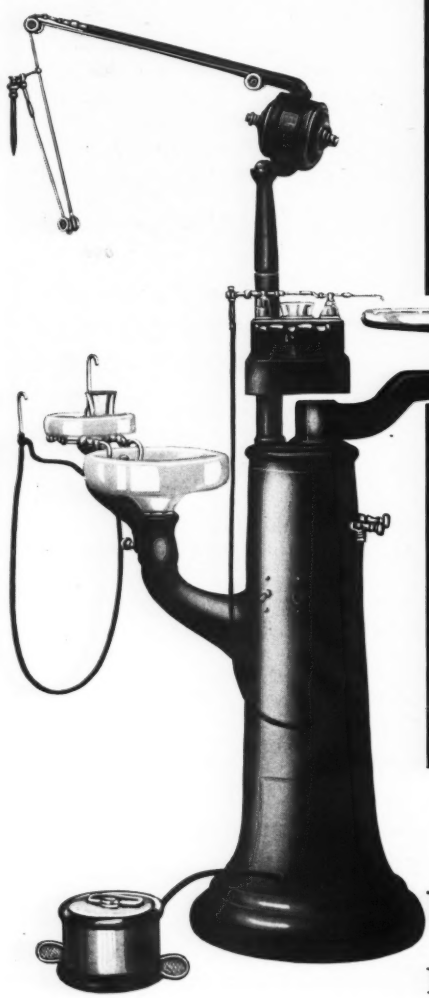
Your magazine is indeed a tribute to dentistry as a profession and a science. It blazes the way for dentistry to advance toward the ideals the older members of the profession have tried to accomplish. We of the younger generation will try to carry on the good work that these leaders have so valiantly started and with the aid of a magazine so well compiled I feel sure that our burden is greatly lightened.—G. J. JAMES, D.D.S., *Cleveland*

I find THE DIGEST a very interesting and helpful magazine, and while I preferred the size of page in the old DIGEST there are many improvements in the present make-up that more than balance that preference.—A. R. MILLER, D.D.S., *Kansas City, Missouri*

I want to congratulate you. It's a wonderful magazine, put up well, and illustrated just right.—H. W. WILLIS, D.D.S., *Murphysboro, Illinois*

You can rest assured that we dentists out here in the great open spaces appreciate your wonderful new magazine. The color reproductions are marvelous, and, I think, mark the renaissance of dental literature and printing. You probably will never know how much work of this kind is appreciated. It is worth a thousand post-graduate courses because it reaches hundreds where classes reach individuals. Keep up the good work!—HARRY G. FARRELL, D.D.S., *Butte, Montana*

TIME TESTED
QUALITY



The Weber Company has made Units for many years and thousands of them. The Nu-Dent model is the result of all the knowledge of good practice gained through this long experience and is the finest Unit we ever offered—yet the price is lower than in years.

We have supplied many Nu-Dent Units and Weber Engines to the U. S. Navy Department where they must meet exacting specifications and pass rigid inspection. The Government insists on the best in materials and workmanship and the fact that Weber equipment has been accepted and re-orders awarded speaks for its quality.

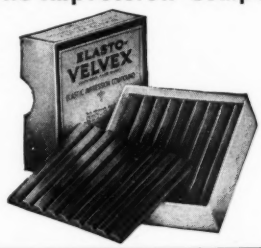
Use the coupon on page 92, for information about the complete Weber line which includes Units, Engines, Lights, Chairs, Cabinets, X-Rays, Cuspidors.

WEBER PRICES ARE MODERATE
Unit $240 Engine $185
Air Cut-Off $10
(Eastern Zone)

THE WEBER DENTAL MFG. CO.
CANTON, OHIO

WEBER
NU-DENT UNIT

ELASTO-VELVEX
Elastic Impression Compound



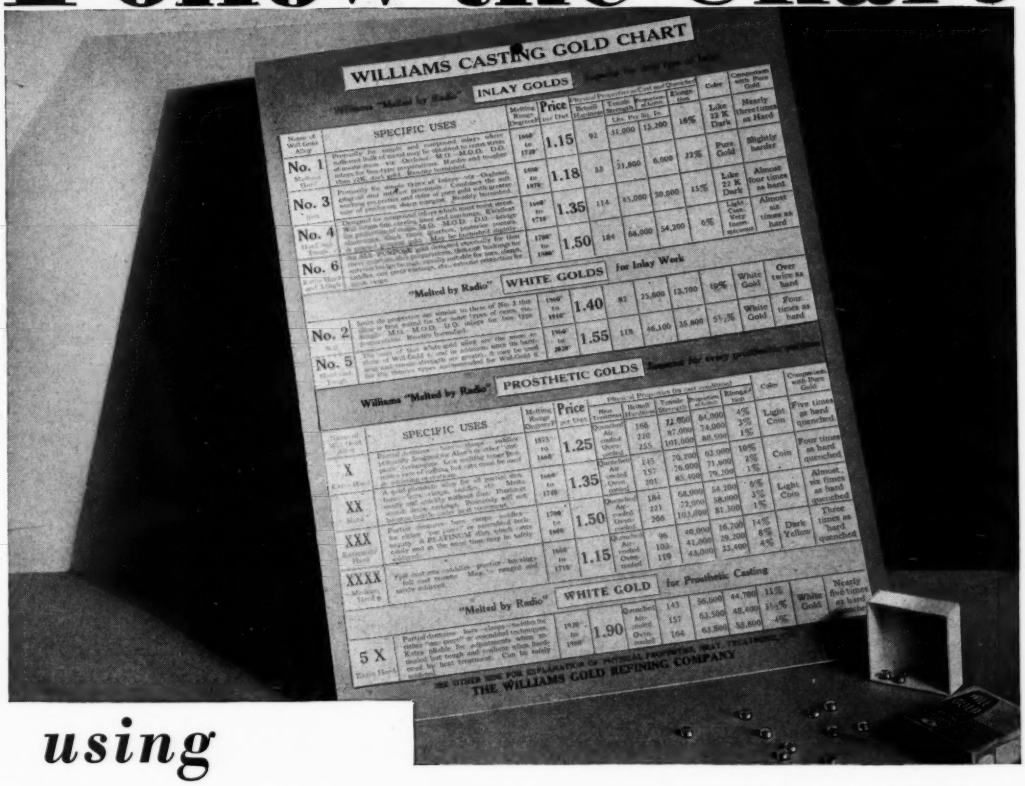
Without ballyhoo, Elasto-Velvex has found a place in the regular practice of many dentists whose opinions we value.
Elasto-Velvex does what is expected of it. Used in place of ordinary compound, its elasticity permits withdrawal from undercuts or irregularities, with assurance that these conditions will be reproduced perfectly in the model.
Its use requires no expensive equipment nor complicated technic, and it does NOT have to be chilled in the mouth.

ELASTO-VELVEX
PLASTIC WHEN WARM
ELASTIC WHEN COOLING
RIGID WHEN COLD

Send for new Elasto-Velvex booklet
See coupon on page 92

BUFFALO DENTAL MFG. CO.
Kehr and Urban Sts. Buffalo, N. Y.

Follow the Chart



using

WILL-GOLD PELLETS

for every casting purpose

Only Williams makes casting golds in the new and better Pellet form. Consult your Williams Casting Gold Chart — Will-Gold Pellets are made for every type of alloy listed. 2 Dwt. and 5 Dwt. packages. Ask your dealer — he will tell you that Williams Gold Pellets —

1. Melt quicker and easier — therefore less oxidation and sounder casting. 2. less waste. 3. more convenient. 4. Absolute uniformity. Try them. Write for latest casting gold chart and Pellet literature.

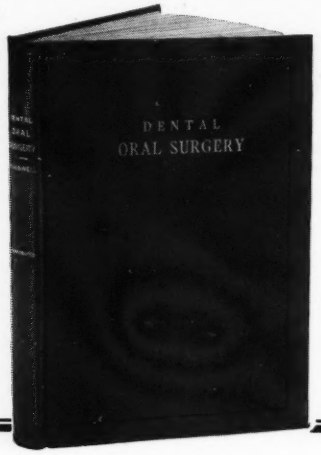
See coupon on page 92

WILLIAMS

THE WILLIAMS GOLD REFINING CO., INC.

San Francisco, Calif. BUFFALO, N. Y. Fort Erie, Ont.

By Wilton W. Cogswell
D.D.S., F.A.C.D.



Up-to-the-Minute
ORAL SURGERY TECHNIQUE

This is 1933 and although general economic conditions may not be moving forward with leaps and bounds, dentistry, a profession, cannot afford to stand still. We do not want the technique of ten years ago, not even of last year, if we can obtain more up-to-date information.

This is the reason we suggest that every dentist consider the new textbook on the removal of teeth by Doctor Wilton W. Cogswell. Doctor Cogswell has been hailed nationally and internationally for his splendid contribution to the subject of tooth removal. It is probable that no dentist ever gave as much of his life's work and thought to the preparation of one book as Doctor Cogswell has given to this book. For over eight years he carved lifelike models out of soap and wax to show his colleagues a method of tooth removal that has proved successful in his practice.

All these wax models, and many other illustrations, are shown in Doctor Cogswell's new book DENTAL ORAL SURGERY. The book gives you the complete technique, step by step, presented clearly and concisely. There are over 500 illustrations showing the reader how to operate for tooth removal using the methods Doctor Cogswell used successfully in daily practice for many years.

DENTAL ORAL SURGERY is a book for every dentist—for the man who specializes and for the general practitioner. The cost is only $10. Order a copy today. The first edition is limited.

See Coupon on Last Page . . .
or Clip this one
and send
TODAY

THE DENTAL DIGEST
1125 Wolfendale Street, Pittsburgh, Pennsylvania

Send me a copy of DENTAL ORAL SURGERY at $10 postpaid.
Remittance enclosed ☐
Send C.O.D. ☐
Charge through dealer with whom I have an active account ☐

Dr.....

St. or Bldg.....

City.....State.....

Dealer.....

"It certainly looks great

Letters and telegrams are coming in already" —E. L.W.

E.L.W. is E. L. Wayman, president of Ritter Dental Manufacturing Company, Inc., the first issue of whose Ritter Counselor appeared last month in THE DENTAL DIGEST.

The same day Albert Scrivener, Ritter advertising manager, wrote: "Just a line to let you know how pleased we all are with the first issue of the Ritter Counselor and also to express our appreciation for the splendid cooperation which you have given us in making this new endeavor possible.

"Your printer too deserves a great deal of credit for having produced such a fine job. As a matter of fact, the final result . . . . is even better than I had anticipated, which is saying a lot."

Then, as Ritter began to hear from readers about the January DENTAL DIGEST advertisement, Mr. Scrivener telephoned, "The response is beautiful!"

Typical comments to Ritter by the profession:

"I was tremendously thrilled this morning to receive THE DENTAL DIGEST and have the real pleasure of reading the Ritter Counselor. May I thank you and congratulate you on this timely contribution to dentistry?

"I am deeply interested in visual education and have for some time wondered how I could work the idea out in my practice—especially with regard to dentistry for children and how to put my message over to parents, so that they would understand what I was talking about and get some of my enthusiasm for better children's dentistry."

"May I compliment your company on the fine . . . . advertising in the last DENTAL DIGEST? It was not only a fine work of art but the subject matter that was contained therein had great educational value."

"The Ritter Counselor . . . . was deeply appreciated.

"It is no question that much dentistry is going by the board because we as a profession are too prone to practice as we were taught. I believe that to be a serious mistake, consequently we must adapt ourselves to the time, cultivate new fields and stimulate and broaden the old ones."

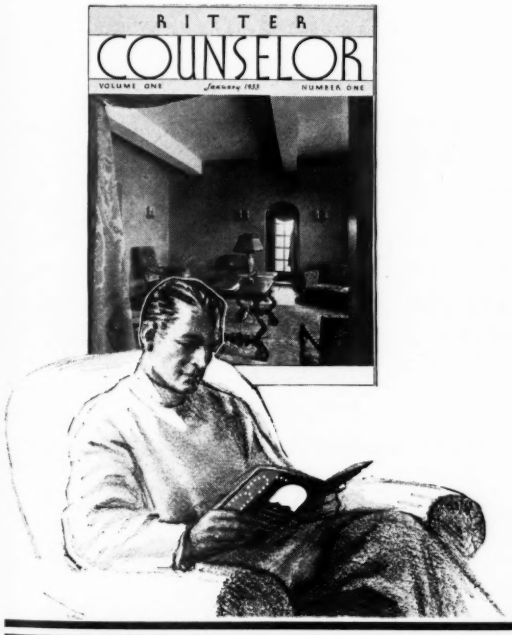
"This morning I received your Ritter Counselor . . . . and was very much pleased with it and the helpful suggestions contained therein. I am principally interested in your article on visual education."

"May I congratulate you on your decision to issue The Counselor? It will be a means of helping the profession."

"Your advertising in THE DENTAL DIGEST is very clever, interesting, instructive, and inspiring. The printing in color of the model reception room is beautiful. I am looking forward to my next copy of THE DIGEST."

Wallace Matthews, of Ritter's Chicago offices, wrote: "Dentists are even calling us up to tell us how wonderful it is and what an inspiration they got from it."

The "cooperation which made this new endeavor possible" is the sort of cooperation which Oral Hygiene Publications' staff offers to manufacturers.



The Ritter Counselor Appears Again Next Month in The Dental Digest

The
DENTAL DIGEST
AN ORAL HYGIENE PUBLICATION

The Second Lot of
DENTAL DIGEST BINDERS
is now ready for delivery

●

Hundreds of dentists, realizing the importance of keeping their copies of The Dental Digest in a compact form, have ordered binders and as a consequence our first lot was exhausted within a very short time. The second lot is now ready and the binders are equally as attractive as the first lot. Order your copy now. The cost is only $2.00. If you want your name and degree stamped on the front cover, the cost is $2.25. Send coupon immediately.

THE DENTAL DIGEST D.D.2
1125 WOLFENDALE ST., PITTSBURGH, PA.

Please reserve binder for me at $2. Name on cover 25c extra ☐

Dr.....

Address.....

See second cover D.D.2

J. F. JELENKO & COMPANY
136 WEST 52ND STREET, NEW YORK CITY

Please send me more information about JELENKO GOLDS.

Dr.....

Address.....

Dealer.....

See page 84 D.D.2

THE DENTAL DIGEST
1125 WOLFENDALE ST., PITTSBURGH, PA.

Send me "Dental Oral Surgery" for $10.

Dr.....

St. or Bldg.....

City.....

Dealer.....

See page 87 D.D.2

RANSOM & RANDOLPH COMPANY
CLEVELAND, OHIO

Please send ..... can of Gray's Investment.

Dr.....

Address.....

Dealer.....

See page 88 D.D.2

BUFFALO DENTAL MFG. COMPANY
KEHR AND URBAN STS., BUFFALO, N. Y.

Please send new Elasto-Velvex booklet.

Dr.....

Address.....

Dealer.....

CO-RE-GA has won the confidence of the Dental Profession the world over.

PLEASE SEND FREE SAMPLES FOR PATIENTS
Dr.....
.....
.....
COREGA CHEMICAL CO.
206 ST. CLAIR AVE., N.W.
CLEVELAND, OHIO U.S.A
This Coupon is for Dentists use Only

The Trial Size CO-RE-GA is Furnished FREE to Dentists
Mail the Coupon for
YOUR SUPPLY

See page 88 D.D.2

WEBER DENTAL MFG. CO.
CANTON, OHIO

Please send information on

Chairs	☐	Units	☐
Engines	☐	Lights	☐
Cabinets	☐	X-rays	☐
Cuspidors	☐		

Dr.....

Address.....

City..... State.....

See page 89 D.D.2

WILLIAMS GOLD REFINING CO., INC.
BUFFALO, N. Y.

Please send descriptive folder on the new WILL-GOLD PELLETS.

Dr.....

St. or Bldg.....

City..... State.....

See ad above D.D.2

COREGA CHEMICAL CO.
206 ST. CLAIR AVE., N.W.
CLEVELAND, OHIO

Please send free samples for patients.

Dr.....

Address.....

New COOK · WAITE

INJECTION TECHNIC PLATES

A permanent aid in your office..
..an invaluable reference for study

FREE

A set of eight technic plates has been designed showing the zygomatic, infraorbital, mandibular and mental nerve block, as well as the supraperiosteal injections for the anterior, middle, and posterior superior alveolar nerves.

These technic plates have been elaborated in cooperation with the oral surgery department of one of the leading American dental schools. They are new in conception and design, showing not only the puncture points and the points of deposit of solution, but also in color the anatomical structures through or near which the needle must pass as it advances into the tissues. This enables the practitioner to visualize each injection clearly and to avoid pitfalls.

For reference in the operating room as well as for study, this set of technic plates is invaluable.

Cook-Waite Injection Technic Plates are given free with the purchase of a specified quantity of Cook or Waite Local Anesthetic Solutions, and are necessarily limited to one set for each dentist.

Please ask your salesman to show you the sample set he carries, or write for further particulars.

Carpule
TRADEMARK REG. U.S. AND FOREIGN COUNTRIES
BRAND
CARTRIDGES · SYRINGES
NEEDLES · · · OUTFITS

Waite's
TRADEMARK REG. U.S. AND FOREIGN COUNTRIES
LOCAL ANESTHETIC

COOK LABORATORIES, Inc. THE ANTIDOLOR MFG. CO., Inc.
170 Varick Street, New York, N. Y.
Canada: Cook Laboratories of Canada, Ltd., Windsor, Ont. Canada: Fort Erie, Ont.

DIVINUM · EST · OPUS · SEDARE · DOLOREM
"ALLEVIATION OF PAIN IS A SUBLIME TASK"
HIPPOCRATES

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OVOID MOULDS
NEW TRUBYTE
OVOID MOULDS
CLASS III—FORM 1
The Typal Ovoid Form in New Trubyte presents all of the true characteristics of the type without the awkward proportions of the extreme examples sometimes seen. The ovoid face is broad, flashy and made up of curves and segments of spheres, and the typal ovoid teeth in this group meet beautifully the requirements in outline, contour and proportion.
CLASS III—FORM 2
The Long Ovoid Form has singularly attractive contrasts showing the delicate double curves on the distal borders, while the form of the laterals provides "tapering" the mesial incisal third over the the cuspids, producing the effect so frequently seen in this type. The long ovoid face requires teeth embodying these features for harmonious renovation.
CLASS III—FORM 3
The Medium Ovoid Form is proportioned for ovoid faces that are neither long nor short, nor so full and rounding as the typal form. This tooth is as suitable for feminine as for masculine ovoid faces, and in showing lines blend perfectly with the curving contours of plump, attractive features. A entirely new tooth form in [illegible] dentistry.
CLASS III—FORM 4
The Short Ovoid Form brings to dentistry for the first time the means to provide beautiful restorations for short ovoid faces, which have be etofore been slighted. This form completes the ovoid group and likewise the most comprehensive assortment of teeth ever produced. Every t[illegible]
MOULD GUIDE
NEW TRUBYTE
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FORM 2
TYPAL OVOID FORM
FORM 3
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FORM 4
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Articulation Chart
NEW TRUBYTE TEETH
THE DENTISTS SUPPLY COMPANY OF NEW YORK
SQUARE MOULDS
TAPERING MOULDS
OVOID MOULDS
NOTE
Lower (6's) Anteriors
NEW TRUBYTE TEETH
IT HAS BEEN definitely demonstrated in our Research Department that there are only slight variations in the character of the lower anterior teeth, and that these only incidental influence on the appearance of dentures, provided they are of proper proportions in relation to the upper anteriors. The 22 lower anterior moulds in New Trubyte meet every esthetic and mechanical requirement for the 100 upper anterior moulds and effect economy and savings for all large users of teeth. They are made in three group lengths, short, medium and long, and are proportioned to match to articulate properly with the moulds with which they are matched. Their development constitutes one of the distinct economies for large users of NEW TRUBYTE.
SHADE GUIDE
NEW TRUBYTE TEETH

THE NEW TRUBYTE MOULD GUIDE

You should have it now for proper selection

Send for Special Offer that will put this New Trubyte Mould Guide in your office at once.